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EDITORIAL

AGRICULTURAL MARKETING

Marketing work was only properly started in this country about two and a half years ago. So much has happened in the interval that it is very difficult to summarise the position briefly.

Up-to-date marketing surveys have been completed by the local staffs in Provinces and States in respect of eight commodities, while another dozen products are under survey. The whole aim and object of the marketing work is to secure better price returns for producers. So far as wheat and rice are concerned, for example, the producer only gets about 60 per cent of the price paid by the consumer. He gets a similar proportion for oil-seeds, ghee and on urban cattle, but for eggs he gets anything from 1/7th to 2/3rds of the consumer's rupee. The position in regard to fruits is much worse. For example 12 per cent to 15 per cent is commonly the producer's proportion on the sale of bananas. For oranges he may get 30 per cent to 40 per cent, but for apples in some cases not more than 20 per cent, while the grower of cigarette tobacco gets only about 44 per cent of the wholesale price in the United Kingdom.

It is apparent therefore that there is ample scope for reducing the price margin between producer and consumer and that this is probably the most promising way of getting better prices for the producer. This is not an easy job. It is a question of improving the efficiency of the present marketing machinery and of reducing costs in detail—here a little, there a little.

When the producer brings his produce to a market he is subject, as a rule, to a large number of petty charges and deductions whose cumulative total is considerable and may amount to as much as 15 per cent. It has also to be remembered that agricultural produce usually passes through more than one market before reaching the consumer. Octroi ~~and terminal~~ taxes bear

heavily and frequently dislocate completely the system of distribution. That transport charges are often too high is clear from the fact that on certain kinds of traffic a reduction of 25 per cent has increased the volume eight or nine-fold.

The waste which occurs is enormous and for wheat alone it is estimated amounts to Rs. 2½ crores per annum. In the case of perishables, such as bananas and oranges, during the hot weather the wastage is frequently as high as 25 per cent or 50 per cent.

Owing to the seasonal character of supplies nearly every kind of agricultural product is subject to considerable price variations throughout the year and buyers have, therefore, to take some risk in regard to prices in future months before the produce enters consumption. In this country, owing to the absence of adequate facilities for ensuring against such price risks, the distributive margin is unduly high to the detriment of producers. Even in the case of perishables for immediate consumption the average daily variation in prices in large representative centres may range from 20 per cent to 40 per cent.

The points enumerated above constitute only a small part of the marketing problems. Another outstanding factor is the question of adulteration. Dirt is frequently added to cereals and oil-seeds, and the position in regard to ghee is notorious. This calls for a stricter administration of the Food Adulteration Acts and of a wider application of the Agricultural Produce (Grading and Marking) Act, 1937, which has already been applied with considerable profit to producers at a number of experimental grading stations operated by the Central Marketing Staff.

Some of the main points calling for immediate attention are the regulation of markets and market charges, the standardisation of weights and measures, the improvement of statistics, the establishment of a better market news service for cultivators, the creation of adequate facilities for dealing in " futures ", improved dry storage for cereals and oil-seeds, cold storage and transport for perishables, the multiplication of special transport rates between certain points, the adoption of uniform standard contract terms by trade associations, and the establishment of allied industries for utilising the surplus produce in certain areas.

There is, therefore, lying ready to hand an enormous amount of work for the local marketing staffs and in this work they require every possible encouragement and assistance of a practical nature.

Fig. 1 The Jat cultivator

Fig. 2 The Rajput cultivator

ORIGINAL ARTICLES

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

VII. THE PUNJAB CULTIVATOR

BY

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The Punjab is not only famous as the 'Sword Arm of India', but it is also well known for its sturdy and virile peasantry, which forms its backbone. The Punjab cultivator has not only proved his mettle on the far-flung battle fields of the Empire, but he is well equipped with sufficient agricultural experience to continue his existence in face of numerous obstacles, difficulties and handicaps.

The cultivators of the Punjab are composed of a number of tribes which claim different origins but possess the same mode of life and general habits. These tribes are not generally localized in special tracts, but are met with throughout the province, predominating in certain districts, while in a minority in others. The customs of the tribes vary with their respective religions, while the agricultural practices in vogue depend on the climatic conditions prevailing in the tracts occupied and on the system of irrigation followed there. Some of the traits and characteristics possessed by the cultivators are tribal, recognizing no religious or geographical boundaries.

Sometimes the Punjabi cultivator appears to be conservative but he is always willing to take up anything new, once he is convinced of its practical utility.

He is simple, sincere and hospitable and is loyal to old and established traditions. He has many weaknesses and defects too, such as superstition, extravagance (particularly on the occasions of deaths and marriages) and has a proclivity to religious fanaticism. With the spread of education, however, there is a slow improvement. Like some other types of cultivator he is rather prone to litigation. He responds more to tactful handling and persuasion than to coercion.

The common food of a Punjabi cultivator though simple in nature is fairly nourishing. Milk, milk products, vegetables, particularly *sag* (greens) and pulses are the most important and common articles of diet consumed throughout

the province. Amongst the grains taken in the form of *chapatis* wheat is most important, but in tracts where *bajra* and maize are grown, wheat is generally supplemented or replaced by them during the winter months. Gram and barley are eaten only by the poorer classes, who cannot afford wheat. With the exception of Kangra and parts of Gujranwala, Sheikhupura, Sialkote and Dera Ghazi Khan where rice is grown and consumed largely, it is considered a luxury, and is only used on ceremonial occasions or for a change. Pulses and *sag* (greens) are commonly used in all parts of the province.

The milk and its products, such as buttermilk (*lassi*), *ghee* and curd are consumed throughout the year all over the province though the quantities consumed vary with the economic conditions of the cultivators. *Ghee*, being costly, is used sparingly by poor cultivators and the surplus stuff is sold in the cities by the housewife. In the districts where sugarcane is largely grown, *gur* and *shakkar* are largely used and when the crushing of cane is in progress large quantities of raw juice (*ras*) are drunk. Meat, being expensive, is only consumed by those of the Muslim and Sikh cultivators who can afford it.

The number of meals taken in a day and the time when they are served slightly vary in different parts of the province, but the regular meals of a Punjabi cultivator are usually two. One of these is served in the forenoon, and the other in the evening after sunset. In addition to these two regular meals, two light ones, one at about 8 in the morning and the other in the afternoon at about 4 P.M., are also usually taken, during the busy season.

Like his food, the dress of a Punjabi cultivator is very simple. It consists of a turban usually of mill-made cloth the length of which varies according to the local custom and according to the social standing of the wearer. The *kurta* or shirt is a loose garment, usually made of *khaddar* (home-spun cloth) and varies in its design according to the local practice. The lower portion of the body is covered by a sheet of cloth also made of *khaddar* called by different names such as *tahmat*, *lungi* and *chadar*. This garment usually reaches to the ankle. When at work, especially during the summer months, this lengthy cloth is replaced by a simpler garment called the *langota*, which terminates near the knees. Sikh cultivators use the *katchera* which resembles an underwear over which they put over the loin cloth. Simple shoes (*juties*) and sandals (*chaplies*) are commonly used as footwear. These are made in the villages. In winter the garments are made of thicker and coarser material and in addition locally-made wrappers are used. In the case of the women there is greater variation in dress than in the case of the men. On ceremonial occasions garments made of mill-made cloth are usually put on.

From the incessant toils, hardships and struggles, which are the usual lot of a cultivator in the Punjab, he finds relief on occasions such as fairs and marriages.

One such occasion is the annual festival of *Baisakhi* which marks the beginning of the harvesting season. Amongst the common sports in the province may be mentioned *kabadi* and *pir-kaudi,* wrestling, lifting and throwing heavy weights. In *pir-kaudi* one man runs and is pursued by two men who try to catch him. He hits with his hands each of his pursuers in turn and then tries to escape. If he is caught during the act of touching the pursuers he loses the game, but if after hitting them he runs away, he wins.

Turning now to the common types of cultivators in the Punjab, the following four types with their tribal characteristics are described below.

1. The Jat

Of all the agricultural tribes found in the province, Jats are by far the most important. They not only excel other tribes in the art and experience of crop husbandry (with the exception of vegetable growing in which Arain leads) but are also found in large numbers scattered all over the province. They predominate in some of the South-Eastern and Central Districts, but are met with in all the remaining parts of the province.

The Jats generally possess very good physique and are very hardy. They not only make good ploughmen but are also brave soldiers. For perseverance, hard work and continuous toil it is very difficult to beat a Jat. A Jat is proud of his profession and is so closely attached to the land that he is always prepared to sacrifice everything to prevent any one taking from him his ancestral land.

Tribal instincts die hard in the Jats and the memory of old family feuds remains ever fresh in their minds. The Jat is, on the whole, of quiet and orderly disposition, but when roused to anger the fighting instinct in him gets the upper hand, unhinging him and upsetting his equilibrium. In some parts of the country in addition to the household duties, the Jatni or Jatti (*i.e.*, the wife of the Jat) also helps her husband in all light field-work.

Jats in the Punjab profess all the three religions of the province, and this change in religion has brought about certain changes in the tribal characteristics, for example, the Sikh business instinct has resulted in the Sikh Jats taking up trade.

2. The Rajput

The word ' Rajput ' is composed of two Hindi words—' Raj ' and ' Poot', meaning the son of a Raja. This tradition of princely origin has imparted a certain sense of superiority to the tribe, and has rendered the Rajput perhaps less inclined to hard work and until quite recently rather averse to agriculture in spite of the fact that a large portion of the land in the Punjab belonged to this tribe.

The race still possesses certain graces. The Rajputs are generally of fine build, usually handsome, and make good soldiers. Amongst landlords the love of horse-breeding, hunting and hawking, and their open-handedness make Rajput land-owners fine country squires. They are usually kind to their tenants, who seek their protection and guidance at all times of difficulty. They generally lead the countryside in social activities and are usually looked upon as models of propriety. Their old men are considered as *grands seigneurs*. Their advice and guidance is sought by the younger members of the family and they exercise a certain amount of patriarchal influence over the countryside.

The womenfolk are strictly in *purdah* and do not therefore help in the fields. This custom is not only confined to the richer classes but is also followed by the peasantry.

The Rajputs are found practically all over the province and they hold a large portion of land. But they predominate in some of the central districts of the Punjab, such as Hoshiarpur, Kangra and Ambala. Where due to subdivision and fragmentation of holdings a Rajput has taken up cultivation with his own hands, he usually cannot compete in skill with his fellow-cultivators, such as Arains and Jats. In his choice of growing crops, he considers it rather below his dignity to grow or sell vegetables, and for the same reason he seldom keeps poultry or increases his income by the disposal of surplus commodities such as milk or *ghee*.

3. The Arain

The Arains claim a Semitic origin and Arabia as their ancestral country. The Arain is invariably a Mohammadan and in his continuous industry, tenacity of purpose, perseverance and agricultural skill comes second only to the Jat in the cultivation of general crops. In raising garden crops he stands unrivalled. While the Jat and the Rajput, particularly the latter, look back to the established customs and old traditions to guide them as to what crops they should grow, the Arain being more practical, pays no exaggerated attention to the past and takes up any enterprise which he considers sound. No work is below his dignity as long as it yields him a living wage. The Arain usually possesses a small piece of land and in order to maintain his family, he has to work very hard. It is really amazing how he overcomes his all economic difficulties by constant hard struggle and thrifty habits. His capacity for work and his willingness to adapt himself to changed conditions are remarkable. He is sufficiently enterprising to migrate abroad.

Obedient, hard working and frugal, neither criminal nor extravagant in habits, the Arain is a model member of an agricultural community. Physically he is not so well built and strong as a Jat or a Rajput but he is intelligent, and as a colonist he is as good as the Jat. In the old districts, where he is in minority, an

FIG. 2. The Jangli cultivator

FIG. 1. The Arain cultivator

Arain may perhaps be looked down upon as lacking in enterprise and stamina, but this is not the case in the colonies.

The Arain has comparatively more experience of intensive cultivation and raising of garden crops. He has established beyond doubt his reputation as a tenant and is welcomed by every landlord in the province.

Like the Jat, the Arain gets help from his womenfolk in light field-work. In the house the woman is very economical and avoids all extravagance and waste.

4. The Jangli

The Janglis are an aboriginal tribe who, till recently, used to lead a nomadic life. They invariably profess the Mohammadan religion and are mostly found in the canal-irrigated tracts of the Multan Division.

Prior to the opening of the Lower Chenab Canal and the colonization of the tract irrigated by it, the Jangli scrupulously kept to his nomadic existence, and refused to take to any settled mode of life. He would breed fine horses and cattle particularly buffaloes, not with a view to making profit thereby, but, primarily to satisfy his own sense of pride by possessing better animals than his neighbours. Cattle lifting was not only considered a good sport, providing amusement for all men of courage, but it was also thought to be an unmistakable sign of superiority. This practice of cattle lifting in the tribe resulted in producing some of the best trackers to be found in the country, who are usually in great demand in the villages whenever a theft takes place. Agriculture was left to dependants of inferior caste.

With the opening up of the canals, however, the Jangli too could not remain unaffected. He soon realised that peaceful pursuits not only brought him more reward, but also provided him better security. We now thus find him engaged in agricultural pursuits along with other colonists in the most fertile part of the province. The Jangli is apt to be extravagant and delights in adorning his womenfolk with trinkets. His hospitality knows no bounds and is proverbial. The Jangli possesses robust health and a good physique, which are mainly due to the dry climate of the tract, to the practice of marrying late and to his diet which is largely composed of meat, milk and milk products.

During the last few decades things, however, have considerably changed, and there is now unmistakably visible an anxiety to marry his children at an early age.

The Janglis still keep to their clannish tendencies. The heads of their clans are aristocrats often possessing a lot of intelligence and ability. They exercise a patriarchal authority over their followers and are of real assistance to the

authorities. Despite a benevolent Nature and sympathetic Government, the Jangli is far from being satisfied with his lot. His main grievance appears to be that, since colonization, he has been deprived of the large grazing areas which he kept for his cattle to roam about and graze. He feels that his freedom has been restricted and he has been forced to handle the plough. His fields tend to be weedy and his plough cattle in poor condition. He will gladly spend large sums in the upkeep of a good horse, but will grudge concentrates to his bullocks.

His instinct for cleanliness in the house is well developed. The houses although *katcha* are scrupulously clean with household articles well arranged. This is mostly due to the womenfolk who not only keep the houses clean and well arranged but also carry on most of the buying and selling on behalf of their men as they are considered better bargainers.

SCIENCE AND PRACTICE OF AGRICULTURE IN INDIA*

BY

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SOILS

THE work on soils has for its ultimate object the maintenance of the high productive capacity of soils which are rich, the restoration to normal those whose capacity has been reduced and to effect an appreciable increase in the yield of soils which are naturally poor. The attainment of these results is based on three fundamental factors in soil management. These are : (1) adequate pore space in the soil not only in the portion turned out by the plough but throughout the effective root zone and within and between the soil crumbs, (2) the existence in the soil of a large amount of plant food constituents not in available forms but in reserve and which, by proper soil management, are transformed into an available state, sufficiently rapidly to meet the requirements of crops, and (3) good tilth and ample crumb structure throughout the root zone which bad management breaks down and good management builds up and maintains.

The important and common characteristics of the majority of the soils are that they are old, have reached a stage of minimum cropping capacity, are subject to intense sunlight and extremes of temperatures and are alkaline in reaction.

In the majority of cases the characteristics and reactions of soils are determined more by climatic factors than by geological origin. For example, the so-called black cotton soils, though of different geological origin, have several important soil characteristics in common. The soil profile does not appear to have the significance that it has elsewhere, probably due to age and to the fact that the majority are transported soils. In several cases, the surface horizons are missing, due probably to erosion through centuries. The profile study is, however, of considerable importance in the field study of the soil as a whole. Such a study has been able to solve the puzzle in regard to the downward movement of water in stiff black cotton soils. It has been ascertained that minute cracks are responsible for the downward and lateral movements of water.

*Extracts from the Presidential Address to the Agricultural Section of the Indian Science Congress, Hyderabad, 1937.

Soil-cultivation

We were taught in the olden days that surface cultivation helps to decrease evaporation and on this basis the better growth of crop in cultivated fields was explained. Recent research has shown that surface cultivation does not help to conserve moisture, but it does not explain its effect on crop growth. Likewise, the object of deeper cultivation was stated to be better aeration of soils. Leather's work shows that gaseous exchange occurs in soils normally to a depth of one foot. The effects of cultivation must, therefore, be looked for elsewhere. One accepted advantage of cultivation is that it contributes to tilth and crumb structure in soils. The satisfactory formation of soil crumbs due to the aggregation of smaller particles by cultivation depends on the stability of these aggregates towards water. The more stable they are, the better they will be from the point of view of crumb formation. In the light of modern work on soil clay, crumb formation and its stability depend on the cationic composition of the clay. It is greater and better for calcium clay than for other clays. The water relationships that exist between clay and water and the salt content of the soil and clay exercise a direct or indirect influence according to conditions. The intermediate stages between complete calcium clay and sodium clay may have varying degrees of moisture requirements for the use of the plough. The usual studies relating to plastic flow and other characteristics of soil are not correlated with the moisture-levels at which the farmer would plough. This is probably because of the aggregation of particles under the intense heat of the sun and the effect of salt concentration due to evaporation.

There is evidence that frequent and deep cultivation is harmful to the soil and to the crop. This is in opposition to what we have been taught but is in agreement with the practice of the cultivator who, except at great intervals of time, does not ordinarily cultivate his soils deeply, nor is he willing to carry out too frequent cultivations of the surface soil. At Hagari in the dry farming tract of the Bellary district, cultivation of black soils to a depth of eight inches every year with a view to conserve moisture was distinctly harmful to crop while, when it was done once in five years, it was distinctly beneficial to both cotton and *jowar*. On the other hand, in the shallow soils of Bombay-Deccan, deep cultivation appears to be beneficial. On the west coast of peninsular India, it is the general practice to plough light paddy soils with excellent results, but the same practice in the heavy delta soils has proved a failure. Recent experience in England also has raised doubts whether deep cultivation or intensive cultivation is really and always good. In an experiment in 1932 in England, neither potato nor sugar beet responded to more intensive cultivation than was necessary to keep down weeds. Indeed, further cultivation beyond this minimum amount did more harm than good.

Fertilizers and manures

The Imperial Council of Agricultural Research has recently collected and collated all the available data on fertilizer and manurial experiments carried out

in India in the past. The evidence establishes the suitability and, therefore, the importance to the great majority of Indian soils of indigenous organic manures like cattle manures, green manures, bone manure and fish manure and oil-cakes ; artificial fertilizers are of importance, but only of secondary importance by themselves, and they show themselves at their best in conjunction with organic manures or when the soil is normally rich in organic matter. In areas of precarious rainfall or inadequate irrigation facilities, artificial fertilizers almost invariably failed to be useful while the effect of organic manures was erratic. With assured moisture supply in the soil, the performance of artificial fertilizers was distinctly better and, in many instances as good as and sometimes even better than organic manures, according to the nature of the crop.

In several cases, the continued use of artificial fertilizers only led to bad residual effects on the soil. When used in combination with organic manures, however, the effect of artificial fertilizers was almost the reverse of that when used alone. Higher dosages did result in higher yields, but these were not commensurate with the expense incurred. The evidence in regard to the time of application of fertilizers is neither extensive nor conclusive. What little there is, indicates that the fertilizers are best applied generally in one application at the time of planting for crops other than sugarcane, which prefers applications in two instalments. The next line of investigation should be of experiment and research on the internal and external effects of time of application to the crop. We have as yet not enough data on the proportionalities of nitrogen, phosphorus and potassium suited to different soils and crops and of the proportions in which organic and inorganic manures should be used.

The average nitrogen content of Indian soils is 0·05 per cent and of organic carbon content is 0·6 per cent. Similar figures for European soils are 0·15 per cent nitrogen and 3 per cent organic carbon. European soils are five times as rich in humus contents and still the demand there is for organic matter. This explains the disappointing nature of fertilizer experiments on Indian soils. The needs of Indian soils are evident and the data from manurial experiments portray the requirements correctly. Cattle manure, green manures and other organic manures are valuable to soils because they supply what is popularly known as humus which is so essential to maintain soil fertility. The cry for organic manures for Indian soils is even stronger and more imperative because the disruption of organic matter is faster at the high temperatures obtaining in India. The rate of destruction can be imagined when it is stated that a soil receiving cattle manure at ten tons per annum in two instalments continuously for over twenty years, contains only 0·74 per cent of organic carbon as against 0·59 per cent of organic carbon in a soil that received no organic manure at all.

The theoretical possibilities of artificial fertilizers are almost limitless, but their achievement on the majority of Indian soils is limited by climatic factors

and economic considerations. In India the major part of its agriculture depends on the monsoon, and therefore, the supply of moisture in the soil is the foremost limiting factor in production. The control of monsoon is beyond our power, but surely we can better conserve and regulate moisture in soils by husbanding the existing resources of indigenous organic manures and using them properly.

Soil organic matter is the life of the soil. It improves the physical condition of the soil ; it provides organic colloidal material which plays a very important part in absorption and exchange. Its value in this respect can be realized when it is said that organic colloids possess four to five times the exchange capacity of inorganic colloids in the soil. It exercises a subtle buffer action and regulates soil reaction within limits. It increases the micro-organic population in the soil. It also increases the solubility of some of the soil constituents and assists in the the more efficient absorption and assimilation of nutrients by plants. The problem of organic manures is therefore of fundamental interest to Indian agriculture. Time was when it was supposed that artificial fertilizers had substituted and would continue to substitute natural organic manures, especially farmyard manure, with equal and even greater efficiency. It is now universally recognized that organic manures, exemplified by cattle manure, are necessary for maintaining soil fertility and that no combination of artificial fertilizers can exercise the steadying effect on crop yields from year to year. It is in the experience of many that at first artificial fertilizers actually give larger yields than organic manures, but later this superiority is not maintained and falls off. Farmyard manure, on the other hand, though less effective in the beginning, is ultimately more effective.

The effect of farmyard manure is seen not only in the total crop-yield but also in the higher ratio of grain to straw compared to artificials. In regard to the composition of the crop, there is no significant variation in nitrogen and potash but striking difference is noticed in the phosphate content of the crop from mineral- and organic-manured plots.

The most striking difference is in the quality of grain as seed and food. Ten years ago attention was called by Viswanath and Suryanarayana, and McCarrison and Viswanath to this important and till then unsuspected aspect of manuring crops.

It would thus appear that if we neglect organic manures and fail to build up the humus content of the soils we shall be doing four things :—

Firstly, we shall not be able to maintain the fertility of the soil.

Secondly, we shall not be using artificial fertilizers to the best advantage.

Thirdly, we shall be failing to keep up the inherent cropping power of our improved seed and run counter to the good work of the plant breeder.

Fourthly, we shall be producing food deficient in nutritive value.

The problem of organic matter and manure supply

It is evident from the foregoing discussion how important organic matter and organic manures are for the great majority of our soils. Soil organic matter or humus is not an imperishable substance but is one that is rapidly attacked and destroyed by processes partly chemical and partly bio-chemical. The two processes are strongly activated by ploughing, which increases aeration and thereby numerous oxidation processes, resulting in the formation of carbon dioxide and nitrogen. The addition of artificial fertilizers will further accelerate the processes of destruction. The introduction of high-yielding varieties and intensive cultivation, lead inevitably to further depletion. It is computed that under our conditions about seventy-five per cent of the fresh organic matter added to the soil and about thirty per cent of the stabilized humus are destroyed annually. The position calls for investigations on the means both for conserving organic matter that is already in the soil and for increasing our resources of organic manures.

By carefully storing the dung, urine, litter and other refuse material, it is possible to conserve this source of supply. The different methods of storage were investigated over a number of years at several centres and it has been found that, by adopting the system in which the cattle themselves compact the manure and litter, the supplies of farmyard manure can be augmented by about fifty per cent. However carefully it is preserved and its quality improved. we cannot get enough of it to meet the requirements. Composting all waste vegetation is another means by which the supply of farmyard manure can be supplemented.

The problem of composting has been receiving considerable attention at the hands of agricultural workers in India. These endeavours have always been to develop a technique suitable to Indian conditions. In the earlier days, it was laid down that the addition of soluble nitrogen to the extent of one to two per cent was necessary. A long series of investigations have shown that such added nitrogen is lost. Loss of nitrogen is related to the loss in dry matter up to a certain limit, although not always correlated. It is not appreciable till the dry matter loss goes above fifteen per cent of the original material. The changes in the details of the technique during the last few years are indicative that the process of composting is still open to further studies.

From comparative experiments with loose-box manures and compost, it would appear that it is the organic matter of the compost or of the manure that is more important than its nitrogen components It would appear that loss of nitrogen does not seem to be an avoidable factor and that the loss again depends on the initial richness of the basic material used for the compost. It would also appear from a study of temperatures that the process is both chemical and bio-chemical, consisting of a low-temperature period of chemical oxidation and a high-temperature period of bio-chemical oxidation. Both the processes proceed side by side, the one or the other being a predominant feature for the time being. The low-temperature

fermentation seems to be more in evidence after the high-temperature fermentation is over and when the apparent stabilized stage is reached. It is possible that the reinforcing of these composts with nitrogen and phosphate at the end of the fermentation period is likely to render fertilizer usage more valuable than it is now. The various methods of composting have each their merits and demerits. While many of the methods proposed are workable on plantation basis, their suitability to the peasant cultivator is doubtful. If composting is to form a regular agricultural practice in India, it is necessary that efforts should be made to make the method simpler and cheaper than what it now is.

The next item for consideration is that of green manures. The cultivator is aware of the benefit of green manure. Whenever possible he has been growing it. But his efforts are limited by considerations of irrigation supply and the circumstances that compel him to take a food or industrial crop instead of a green-manure crop. What is required is an industrial green-manure crop like indigo, which can bring him direct financial return leaving the plant residue on the farm. According to James Morton (*Chemistry and Industry*, 1930) we had in India some 1,300,000 acres growing indigo plant, yielding some 22,000 tons a year of what is now known as standard indigo paste, valued at about £4,000,000 and employing, it is said, some 6,000,000 people. Unfortunately, artificial indigo and other blue dyes are such formidable competitors to the natural indigo that it appears to be beyond the possibility of human effort to restore indigo cultivation to its former position. Any endeavour in the direction of facilitating indigo cultivation will be greatly appreciated by the farmer.

Problems of food and nutrition

The problems of food and nutrition are in the forefront, not only in India but all the world over. No apology is, therefore, needed for considering them briefly under the two heads, quantity and quality of production. The question of nutritive quality has already been considered in the foregoing pages and we have seen how soil conditions can influence the nutritive quality of crop, and the means by which suitable soil conditions can be maintained. In regard to the quantity of production, it may be conveniently examined on the basis of protein requirement, which again may be conveniently considered in terms of nitrogen. If we arrive at the probable quantities of protein requirements and the amount of protein produced by way of food crops, we can form an idea whether the position is one of surplus or deficit. These calculations are admittedly not accurate estimates but they give us a picture of the position in regard to the production of food crops.

A. W. Flux, in his Presidential Address to the Royal Statistical Society (June, 1930) on 'Our food supply before and after war', fixed 86·5 grammes of protein per head per day in England. This is equivalent to fourteen grammes of nitrogen

per head per day. For India, I have assumed that the food requirements are lower and have taken an average of seventy-five grammes of protein consumption per head per day. This is equivalent to twelve grammes of nitrogen. On this basis, the annual requirement of nitrogen, necessary for feeding a population of 353 millions, works out to 1,522,312 tons of food nitrogen for the whole population or 9·66 pounds of nitrogen per head per year. From the 247,000,000 acres under cultivation with various food crops, a total of 1,071,138 tons of food nitrogen are available.. Thus, we are short by roughly 500,000 tons of food nitrogen. In other words, we are at present producing food sufficient for the proper feeding of only two-thirds of the population.

The supply of food has to be increased by increasing the outturn per acre and by bringing more land under cultivation. With high-yielding strains of crops and suitable soil management, it should be possible to increase production sufficient to meet the needs. Our botanists can and are producing high-yielding strains which, on the average, give ten to fifteen per cent increase in yield. A quarter of a century of experimental work has demonstrated that by rational soil management and manuring, a further increase of ten to fifteen per cent can be expected. The results of recent sugarcane-growing competition under the auspices of the Maharashtra Chamber of Commerce, Bombay, show that large increases are not impossible. In these competitions, the Kalamb Sugar Factory harvested as much as 104·28 tons of cane to the acre. Several other factories recorded 80 to 100 tons of cane to the acre as against the normal average of about forty tons to the acre.

Conclusion

Indian agriculture is one of great antiquity and many of the present-day practices are the outcome of experience through at least fifty centuries. The Royal Commission on Agriculture in India, after an extensive and careful study, have recorded that the system of agriculture and the agricultural practice in vogue, stand unchallenged by modern research. We are dealing here with soils and practices several centuries old. We have seen how intensive cultivation even in the comparatively infant soils of Europe and America is bringing about experience, which ten or fifteen years ago would have been incredible. The experience with frequent cultivation, the effect of organic matter and the cry for more of it are instances in point. The effect of intensive cultivation and the intensive use of fertilizers in India without the necessary accompaniments is obvious.

Time was when the Indian cultivator was considered conservative, superstitious and unwilling to take advantage of improvements. Close contact with him has shown that he is neither of these and his reluctance is based more on common sense. He is quick to realize benefit where it lies and is quicker still to take advantage of it. His willing response to the various improvements suggested to

him during the past quarter of a century is eloquent testimony to his readiness to take up any improvement suited to the conditions with which he is faced. It is true he is fatalistic, but what else can he be, depending as he does on the vagaries of monsoon? It is this fatalism, and its concomitant spiritualism, that make him such a stable element of society. Research should concern itself more with details of existing practices than with the evolution of wholly new methods and should aim at building up on the existing system a state of agriculture to suit the condition of the soil and the resources of the cultivator.

PERPETUATION AND CONTROL OF SEPTORIA DISEASE OF WHEAT IN THE PUNJAB

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I. Introductory

Septoria tritici Desm. occurs practically in all the wheat-growing countries of the world, as reported by Ferraris [1915] from France, Sorauer [1908] from Germany, Cooke [1906] from England, Weber [1922] from the United States of America, and Sydow and Butler [1916] from India. In the Punjab, where wheat is an important staple crop, the disease occurs in many districts and is increasing in seriousness every year. The writers, therefore, realising its developing economic importance, undertook a study of the modes of its perpetuation and measures of control. The paper contains an account of the work done on these lines during the last three years.

II. Symptoms of the disease

The detailed symptoms of the disease have already been described by the authors [1937] and need not be repeated here.

The appearance of the disease in the field depends on the weather conditions, chief of which is rainfall. Thus, in certain years, the disease is noticeable as early as the last week of December, when the crop is about six weeks old, provided there is a shower of rain in the beginning of that month, while in other years it may appear as late as the middle of February.

From a distance, the leaves of the diseased plants look yellow, and it is only on a close examination that the pycnidia of the fungus can be seen and the disease recognised. If the disease appears early, the affected leaves shrivel and die, but if it is late, only partial drying up of leaves takes place. The disease continues to spread by secondary infection and develop till the end of March provided the season is comparatively moist. After this its further development ceases altogether or is very slow on account of rising temperature. (In April the normal mean temperature at Lyallpur is 26° C.)

Young and old plants have been found to be equally susceptible to the disease, but the young plants are more severely injured than the old ones.

III. Modes of perpetuation of the disease

It has been found that the disease is not perpetuated through seed and soil, but is carried over from year to year by the following means :—

(1) by diseased wheat plant debris which may remain lying on the surface of soil after the crop is harvested,

(2) by diseased wheat straw used in making *bhusa** stacks and

(3) by *bhusa* made from diseased wheat leaves.

Experiments supporting these conclusions are described below :—

1. *Seed infection.*—In 1934 as well as in 1935 sections of hundreds of grains obtained from wheat plants affected severely with *S. tritici* were cut and examined. All such grains were found to be free from infection. Similar grains after surface sterilization were also incubated on sterilized oat meal agar tubes but no fungus grew from such seeds. It is therefore concluded that wheat grains are not infected by the fungus.

2. *Spores on the surface of grains.*—It has been found that pycnidia do not liberate pycnospores unless they get moistened. If the conditions are dry during the threshing of wheat, pycnidia will remain intact on infected wheat straw and pycnospores will not come out. There is, however, the possibility of rain during the threshing period as has happened for several years in the past. Under such conditions pycnidia being wetted swell and liberate spores. These spores on coming in contact with grains adhere to their surfaces, and germinate in from six to thirty-six hours. The germ tubes, however, wither away as there is no wheat crop to infect.

With regard to spores left exposed to dry conditions it has been found that they lose their viability in about two weeks in summer. To investigate this wheat

*Wheat straw broken into fine pieces is called *bhusa*.

grains were smeared with spores and examined periodically. They failed to germinate, after a lapse of fourteen days.

3. *Soil infection.*—A large volume of diseased leaves and straw of wheat collected in April 1934 was chopped into fine pieces and buried at a depth of two to three inches in sterilized soil in ten pots on 15th May 1934. The pots were examined in the last week of September 1934. It was found that all the infected material had rotted. Samples of soil were taken from each of the ten pots and were poured into culture plates in accordance with the usual technique. No colonies of *S. tritici* developed in any of the plates even at the end of four weeks. But colonies of *Alternaria* sp., *Aspergillus* sp., *Mucor* sp., and *Fusarium* sp. had appeard.

On 5th November, 1934, healthy disinfected seed grains of wheat variety 8A were sown in the above-mentioned ten pots. These pots were kept protected from outside sources of the infection throughout by screens. The pots were covered by bell-jars lined with moist blotting papers for sever days in January and then for seven days in February, in order to provide moist conditions for the development of the disease in case the causal fungus in viable form was present. By the end of the wheat season the plants in all the pots were found free from the disease. Wheat plants grown in ten sterilized pots and kept under similar conditions, but which were artificially infected with a spore suspension of *S. tritici*, showed the disease.

These results, therefore, show that the fungus on the infected debris cannot survive during summer when buried in the soil and that the fungus, unlike soil-inhabiting fungi, does not live saprophytically in the soil.

Other experiments conducted showed that the fungus on the infected wheat plant is killed if it is buried at a depth of 1½ inches or more even for so short a period as one month during summer.

4. *Diseased wheat plant debris on which the causal fungus remains alive.*—The diseased wheat leaves from the harvest of 1934 were collected and were kept under the following conditions :—

(*i*) In incubators at different temperatures ranging from 10-40° C. (from June to October 1934).

(*ii*) Outside in the sun throughout summer (from June 10th to 7th October 1934, the temperature ranged between 12·5° and 58° C.)

(*iii*) Outside in the shade throughout summer (from 10th June to 7th October 1934, the temperature ranged between 12·5° and 47·7° C.)

The germination of the pycnospores taken out from pycnidia borne on the diseased leaves kept under different conditions was tested from time to time and the results are given in Table I.

TABLE I

Percentage germination of pycnospores from the material exposed under different conditions

(Experiments started on 10th June 1934)

Time	Outside in sun	Outside in shade	40°C	35°C	30°C	25°C	20°C	10°C
After 1st week .	62·5*	75·8	16·8	33·1	40·8	60·3	85·4	90·5
„ 2nd „ .	65·3	79·7	18·2	33·3	36·9	50·1	78·6	89·7
„ 3rd „ .	62·7	73·7	15·6	29·3	38·3	55·4	84·9	70·9
„ 4th „ .	53·2	70·0	17·2	22·3	29·9	55·5	75·5	88·6
„ 5th „ .	60·3	55·5	15·5	20·4	28·6	39·06	76·9	87·7
„ 6th „ .	63·4	58·9	15·0	20·1	20·7	25·4	71·7	86·4
„ 7th „ .	52·6	60·5	9·36	10·8	25·1	40·7	68·9	89·6
„ 8th „ .	63·1	55·3	0	0	20·9	32·4	70·8	70·4
, 9th „ .	53·8	54·9	0	0	22·8	25·9	50·9	65·5
„ 10th „ .	49·0	45·8	0	0	20·8	24·5	45·7	71·4
„ 11th „ .	53·1	54·6	0	0	0	25·1	55·9	73·2
„ 12th „ .	41·4	45·8	0	0	0	26·1	45·5	75·6
„ 13th „ .	35·5	43·5	0	0	0	27·4	40·4	74·4
„ 14th „ .	38·9	38·7	0	0	0	25·5	47·7	65·5
„ 15th „ .	31·4	34·5	0	0	0	23·4	39·5	55·9
„ 16th „ .	25·9	28·9	0	0	0	20·8	50·6	70·7
„ 17th „ .	22·8	30·5	0	0	0	28·9	55·5	65·9

* Every figure in the table is based on a count of 1,000 spores

It is clear from the results given in Table I that pycnospores while still in the pycnidia borne on infected leaves lose viability after eight weeks' exposure at 35° and 40° C. respectively. Similarly the pycnospores die after eleven weeks at 30° C. But twenty-eight, fifty-five and sixty-five per cent of the pycnospores retain vitality even after seventeen weeks at 25° C., 20° C. and 10° C. respectively. About twenty-two per cent of the pycnospores remain alive on the material kept outside in the sun, and thirty per cent on the material kept outside in the shade during summer. It was noticed, however, that the number of pycnospores in the pycnidia borne on the material placed outside under natural conditions decreased by about seventy to eighty per cent.

It was further considered necessary to test whether the fungus on such material was capable of causing infection or not. For this purpose the following experiments were arranged.

Experiment I. Pycnospores from the diseased material exposed under different conditions were suspended in sterile water and wheat plants inoculated with them.

Experiment II. The plants were directly inoculated by tying up the diseased leaves exposed under different conditions to healthy plants.

The observations were recorded after twenty days and the results are given in Tables II and III.

TABLE II

Results of inoculation experiments by pycnospore suspension directly obtained from diseased debris (leaves) of April 1934

(Date of inoculation 20th December, 1934)

Conditions under which the material was kept	Number inoculated		Number infected			
	Plants	Leaves	Plants	Per cent	Leaves	Per cent
1. Outside in sun . .	100	580	100	100	500	86·2
2. Outside in shade . .	98	588	97	98·9	504	85·7
3. In incubators :—						
i. at 25°C . . .	95	499	83	87·3	337	66·6
ii. at 20°C . . .	90	520	90	100	490	94·2
iii. at 10°C . . .	98	570	98	100	470	82·4

TABLE III

Results of inoculation experiments by tying the diseased leaves of April 1934 to healthy plants

(Date of inoculation 20th December, 1934)

Conditions under which kept	Number inoculated		Number infected			
	Plants	Leaves	Plants	Per cent	Leaves	Per cent
1. Outside in sun . .	10	25	10	100	25	100
2. Outside in shade . .	10	26	10	100	26	100
3. In incubators :—						
i. at 25°C . . .	10	23	10	100	23	100
ii. at 20°C . . .	7	25	7	100	25	100
iii. at 10°C . . .	9	26	9	100	26	100

It is clear from the results embodied in Tables II and III that spores of the fungus in the pycnidia on the leaves kept during the summer months outside in the sun, outside in the shade and in incubators at 25° C., 20° C. and 10° C. remain alive, and that these are capable of causing infection in the subsequent wheat crop.

5. *Diseased wheat straw used as enclosure in making* bhusa *stacks.*—From June 1934 diseased leaves from the enclosure of *bhusa* stacks of April 1934 at Lyallpur were collected at intervals and the germination of pycnospores got from pycnidia on the leaves was tested. The results are given in Table IV.

TABLE IV

Percentage germination of pycnospores from diseased leaves obtained from bhusa *stacks of April 1934*

June	July	August	September	October 1934
75·3	45·3	32·1	23·7	16·9

It is clear from these results that the pycnospores of the fungus while held in the pycnidia borne on these leaves remain viable throughout summer though the viability of the spores diminishes with age. To test whether the fungus in these leaves was capable of causing infection or not, experiments similar to those described under III (1) above were conducted on 205 plants. All the inoculated plants showed infection and ninety per cent of the leaves were also infected. Thus it is evident that the fungus from the diseased straw of *bhusa* stacks is capable of causing infection.

6. Bhusa *made from diseased wheat leaves.*—*Bhusa* collected from various *bhusa* stacks of April 1934 in Lyallpur during December and January showed on examination the presence of pycnidia of the fungus on some pieces. Six to eight per cent of the pycnospores in these pycnidia were found viable and these, when sprayed on healthy plants caused infection, thus showing that the fungus remains viable in *bhusa* made from diseased wheat plants and is a means of carrying over the disease.

IV. SPREAD OF THE DISEASE

The fungus *S. tritici* Desm. does not produce the air-borne type of spores. Dry infected leaves studded with pycnidia were shaken over sterilized slides but no spores were shed. Similarly they were shaken on culture plates but no growth of the causal fungus appeared. But when the same leaves were drenched with water, the pycnidia swelled and the spores oozed out. High atmospheric humidity alone could not liberate the spores. Further the examination of the slides which after having been smeared with vaseline and placed in an aeroscope, were exposed

for a week near a field (about twenty feet) of wheat affected with *Septoria* disease, did not reveal the presence of any spores of *S. tritici*, thus showing that the spores of this fungus are not blown about by wind. During rain, however, they are carried to some distance in the form of fine spray. Wind, nevertheless, even under dry conditions, plays an important part in the spread of the disease. Portions of the diseased leaves totally dry up, fall and are blown about by wind and are lodged amongst healthy wheat plants. In wet weather pycnospores ooze out of pycnidia borne on wheat leaves. They cause infection when they fall on the wheat plants. In wet weather, water drops which are actually in contact with pycindia , carry spores and these are carried away in suspension by wind. Dissemination of the disease is thus brought about in these ways.

V. Control measures

A. *Suppression of the sources of infection.*—The following sources of infection as described in the preceding pages have been discovered :—

1. Diseased wheat plant debris left on the surface of the soil.
2. *Bhusa* stacks of a diseased wheat crop.

Practical suggestions for suppressing these sources of infection are given below :—

(1) *Diseased wheat plant debris left on the soil surface.*—The diseased wheat plant debris is left behind in many ways after the crop is harvested and threshed. It is not unusual that the diseased leaves dry up and drop on the soil surface, whence, through the agency of wind, they may be blown away to neighbouring fallow or cultivated fields. But if hedges come in their way, they may get entangled in them and form a centre for continuous infection.

Further, when the crop is threshed some diseased wheat straw is left behind on the spot and is subsequently dispersed. The trouble will increase if permanent threshing floors are used and they are not cleaned at the end of the threshing season.

In the process of winnowing, again, a part of the infected wheat straw may be gradually blown away to distant quarters.

The above processes of dispersal of infected straw are helped by wind storms which blow usually in the months of April and May, in the Punjab.

For successful control of the disease, therefore, diseased plant debris should be controlled. Generally farmers plough up the harvested fields and threshing floors with the *desi* plough after the first shower of rain. This process is very helpful in destroying the affected plant debris. It is, however, advisable that a furrow turning plough should be used for first ploughing, so that the diseased plant debris is buried in the soil and thus the fungus is killed. Thorough and careful weeding of the *bands* of fields should be taken in hand and hedges should be cleaned up every year.

2. Bhusa *stacks of diseased wheat.*—It is customary with the Punjab farmers to stack *bhusa* on farms outside the villages. Diseased wheat straw enclosure is a constant source of infection. When it rains and wind blows, the spores get dispersed by splashing from the wheat straw enclosure of the *kups* (*bhusa* stacks) and infect the crop in their vicinity. When *bhusa* is taken out from stacks, some of it falls down there and is later blown about by wind and under moist conditions it causes infection. The danger is more so as *bhusa* stacks are well distributed in the entire lot of the village fields.

The introduction of such a system of stacking *bhusa* as will check the spread of the disease in the succeeding years is absolutely necessary. To achieve this a few suggestions are made as under :—

Bhusa should not be stacked in or near the fields where wheat is to be sown. In fact, it should be away from the cultivated area. From the point of view of disease control the stacks should be well plastered with mud. Where it is not possible to do so it is suggested that, at least on large holdings, *kacha* sheds should be erected for stacking *bhusa.*

While carting *bhusa* from one place to another during the growing season of wheat, *bhusa* should not be allowed to drop on the way.

B. *Growing resistant varieties.*—Another alternative for dealing with this disease is to grow wheat varieties that are resistant to the disease . With this end in view all the available Punjab wheat types (grown in pots as well as field) were thoroughly tested (more than 1,000 plants in each case) and the results of inoculation are given in Table V.

TABLE V

Relative resistance of Punjab wheat types

(Date of inoculation 14th January, 1935)

Wheat types	Per cent infected leaves	Remarks
8-A ; 8-B ; 9-C ; 9-D ; 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, C. 409 ; C. 499 ; C. 518 ; and C. 591.	70	All these are of *Triticum vulgare.*
4, 5, 6, 7, 8, and 25 . . .	50	Types 4 to 7 are of *T. compactum* and Types 8 and 25 are of *T. vulgare.*
1 2 and 3	0	Types 1 to 3 are of *Triticum durum.*

It is clear from the results that while all the *compactum* and *vulgare* types of wheat are very susceptible to the disease, the *durum* are immune. As the *durum* types are not suitable for growing everywhere, hybridization should be resorted to for evolving varieties of *Triticum vulgare* resistant to *S. tritici.*

VI. Summary

1. The field appearance of a disease of wheat caused by the fungus *Septoria tritici* Desm. is described.

2. Modes of perpetuation of the disease from year to year have been discovered. These are :—

(*i*) The pycnospores of the fungus, while held in the pycnidia borne on diseased wheat straw used as enclosure in making *bhusa* stacks, remain viable throughout summer. The pycnospores of the fungus from such straw cause the disease in the next wheat crop.

(*ii*) The fungus also remains viable in *bhusa* made from diseased straw and also in the diseased leaves which may remain lying on the surface of the soil during summer. The pycnospores of the fungus from such diseased tissue can initiate infection in the subsequent wheat crop.

3. Measures to control the disease are suggested. These deal with the suppression of the sources of infection described.

4. Relative resistance of the Punjab wheat types has been studied and it has been found that the *durum* types are almost immune and *compactum* and *vulgare* types are susceptible to the disease.

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COMMON CONTAGIOUS AND PARASITIC DISEASES OF POULTRY IN INDIA AND THEIR CONTROL (PART II)

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(*Continued from Vol. VII, Part VI of this Journal*)

Fowl spirochaetosis

It is usually a fatal septicæmic disease of chickens, geese and ducks, caused by a screw-shaped blood parasite, *Spirochaete gallinarum*, transmitted by certain ticks, the one responsible in India being *Argus persicus* (Plate III, fig. 1). The disease appears to be quite common in India. The tick may retain the spirochaete in its body for six months and also transfer it to the offspring, the disease thus remaining endemic. Fresh stock when introduced into infected premises pick up the tick and get the disease. The tick causes a great deal of damage especially in young birds on account of its blood-sucking habits, besides acting as a carrier of this disease.

The affected birds show inappetence, rise of temperature (108°-112°F.), marked weakness and somnolence, paleness of the comb, frothing from the beak, diarrhœa and emaciation. A certain amount of paralysis of the legs, swelling of the feet, backward turning of the toes and turning of the neck to one side with the head well hidden under the wing may be observed. In later stages the comb takes a bluish red colouration, the temperature falls rather abruptly which coincides with the disappearance of the parasite from the circulating blood, the paralysis of wings, neck and legs becomes pronounced and the fowl lies prostrate on the ground with the neck hanging down. Death in acute cases occurs on the third or fourth day of illness, whereas chronic cases may last for eight to fourteen days.

On *post-mortem* examination, in acute cases there is enlargement of the spleen and liver and the intestines show congestion and petechial hæmorrhages. Fatty degeneration and focal necrosis are common in the liver.

The disease can be diagnosed by detecting the actively motile spiral causal organism in wet blood preparations or stained blood smears prepared at the height of temperature (Plate III, fig. 2).

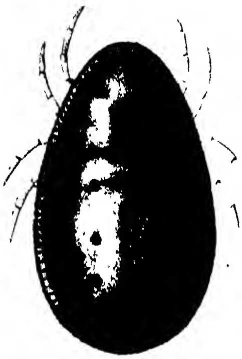


Fig. 1. *Argas persicus*, the common poultry tick in India, which transmits fowl spirochaetosis.

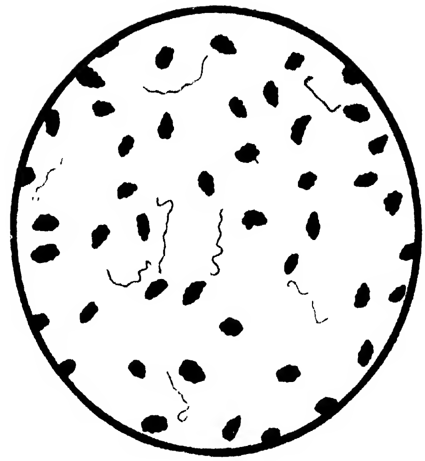


Fig. 2.
Spirochaete gallinarum in chicken blood.

Fig. 3. The common round-worms and caecum-worms of fowl (After Gawtkin and Glover)

Fig. 4. The common species of tape-worms from the

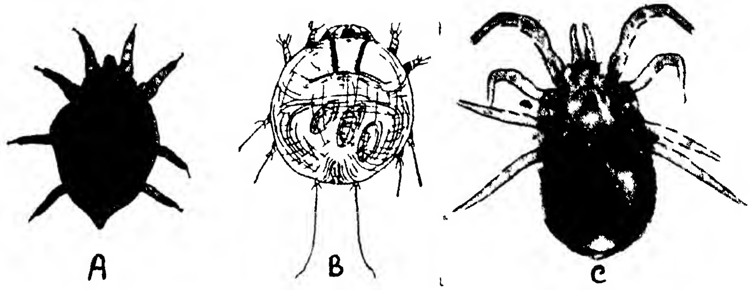
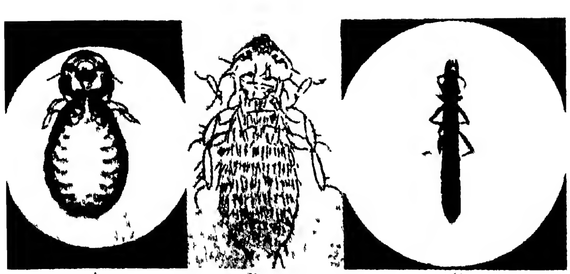


Fig. 1 A *Cytoleichus (cytodites) nudus* B *Cnemidocoptes gallinae* C *Dermanyssus gallinae*

Fig 2. Scaly leg (After Gawtkin and Glover)



A B C

Fig. 3 A *Goniocotes hologaster*, B *Menopon biseriatum*, C—*Lipeurus heterographus* (After Beach and Freeborn)

For its control it is essential to eradicate the tick from poultry houses. To effect this, thorough cleansing of the premises, burning off the old roosts and nests and brushing the walls with hot coal-tar, which can flow into the cracks, are necessary. Brazier's blow lamp's flame can be effectively used for disinfecting the various fittings in the poultry houses. Roosts should have no bark and should be suspended by wires so as not to touch the walls, in the crevices of which the tick hides during the day. Since the tick is nocturnal in habits, the birds may be isolated at night to prevent its attack.

A natural attack of the disease confers an immunity which has been shown to last for at least six months and probably longer. Defibrinated blood alone after storing for two to four days or heating for five to ten minutes at 55°C. or glycerinated or formalised blood may be used as a vaccine, the formalised one being superior to others. Birds which are to be introduced into infected premises should be vaccinated previously. An antiserum prepared from donkeys or horses is also protective against this disease. Among the chemotherapeutic agents Salvarsan in doses of 3·5 milligrammes per kilogramme body-weight or Soamin in doses of 10 milligrammes for an adult bird of average size and weight may be injected, dissolved in sterile distilled water, under the wings in the pectoral muscles as curative.

POULTRY

A. Round worms

Serial No.	Name of the parasite	Synonym	Description	Host	Location	Life-history
			(i) Roundworms of the digestive tract			
1	*Gongylonema ingluvicola.*	The crop worm.	It is slender, elongated and about 3/5 in. to 4/5 in. long.	Fowls and Turkeys.	Crop . . .	Indirect, dung beetles being the intermediate host in which the worm eggs taken in with birds' droppings hatch and become larvae and by their ingestion infestation of other birds occurs.
2	*Cheilospirura hamulosa.*	The gizzard worm.	It is a slender worm and about 1/2 in. to 3/4 in. long.	Chicken and Turkeys.	The parasite burrows into the wall of the gizzard producing tunnels in it and leaving round holes with raw edges on its inner lining.	Indirect, with grasshoppers as the intermediate host.
3	*Tetrameres americana.*	The stomach worm.	The male is slender and elongated but the female is almost spherical and bright red in colour when full fed.	Chicken	In the wall of the proventriculus, *i.e.* the glandular stomach, which becomes swollen.	Indirect, with grasshoppers and cockroaches as the intermediate hosts.
4	*Ascaridia lineata.*	The large round worm of the intestine.	It is about 1 in. to 4 1/2 in. long, when fully grown.	Chicken, and less commonly geese, ducks and turkeys.	Intestine (when present in large numbers, may even block the lumen).	Direct, *i.e.* the eggs passed out in the droppings develop and hatch in the soil and on being swallowed by the birds they develop into sexually mature forms.
5	*Capillaria* (*C. retusa*, *C. columboe*, etc.)	The thread worm.	The male is about 3/10 in. to 1/2 in. and the female is about 1/2 in. to 4/5 in. long. They have slender elongated anterior portion and a comparatively thicker and shorter posterior portion, *i.e.* whip-like. It is not common in India.	Fowls and pigeons.	Intestine, especially near to the gizzard.	Ditto.
6	*Heterakis-gallinoe.*	The caecum worm.	It is about 3/10 in. to 1/2 in. long (is involved in the transmission of blackhead disease of turkeys).	Chicken, turkeys, guinea-fowls, geese and ducks.	Caeca or blind guts.	Ditto

WORMS

(Plate III, fig. 3)

Symptoms and lesions	Prevention	Treatment
Fowls and other domestic birds are more or less infested with worms. As a rule, both round and tape-worms produce similar symptoms but generally round worms, unless the infestation is very heavy, cause very little symptoms, whereas comparatively small number of tapeworms may do so. It should be remembered that slight infestations that are unchecked become serious through the birds picking up more eggs or larvae. Apart from the direct harmful results of worms which are much greater than generally realized, the general condition of an infested flock is lowered and they are more susceptible to other diseases.	The following general measures for the control of both round and tapeworms are useful :— 1. Proper drainage and filling in of the holes and ditches are essential because damp and low-lying places provide an ideal place for the breeding of intermediate hosts like flies, beetles, slugs, snails, earthworms, etc. 2. Keep the yards free of boards and miscellaneous objects which provide shelter to intermediate hosts or carriers like cockroaches, etc. 3. Raise young birds, which are more susceptible to parasitic infestation, away from the older birds which are often carriers of parasites, and from the infected areas occupied by them.	Any-one of the following treatments may be applied :— 1. Feed the birds as usual the morning before treatment and then keep them enclosed. Following morning feed as much as the birds eat with the following mixture which will be enough for 15 birds :— One tablespoonful of lye (crude soda alkali) and one gallon of wheat and oats mixture, boiled for two hours, after the addition of sufficient water for boiling, and cooled.
Young birds are affected more seriously than the old ones. In a moderate infestation the appetite may be ravenous and great thirst be manifest. If heavily infested, the birds become weak and unthrifty, egg laying falls off and the condition of the flock is generally poor. The feathers are ruffled and the comb and wattles are pale. Digestive disturbances are indicated by diarrhoea or sometimes constipation and loss of appetite. Wry neck is not infrequently seen, especially in tapeworm infestation and leg weakness may occur in later stages of the disease.	4. Rotation of yards. The ground should be ploughed under and some green crop grown when it is not in use. This will reduce the number of common intermediate hosts and parasitic infestations. 5. Frequent removal and proper disposal of the droppings is required. These should be stored for about a month in a barrel with a tightly fitting lid before use as manure, in order to destroy the worm ova or else this manure should be used on such fields only which will not be used as a poultry range. 6. The perches and resting places should be dusted with lime and ashes. 7. Containers for food and water should be kept clean and not allowed to be contaminated with the birds' droppings.	Supply drinking water separately as usual. Twenty-four hours later follow the treatment with one teaspoonful of Epsom salt in mash for each bird or nearly one pound for 100 birds. 2. Dry mash containing 2 per cent of tobacco dust (with at least 1½ per cent nicotine content) may be fed to the flock for 3 or 4 weeks. 3. Oil of chenopodium in doses of one teaspoonful for twelve birds, mixed in mash may be given after fasting as in No. 1.
On *post-mortem* examination one finds the parasites in their locations with inflammation of the infested parts and the presence of nodules especially in large tapeworms infestation. The infested part with its contents should be washed with water in a basin for easy detection of small parasites.	8. Build up the resistance of the flock by feeding on nutritious and balanced diet, rich in vitamins. 9. Kill all those birds which show marked clinical symptoms and remove others to clean dry quarters, under strict sanitary conditions for treatment.	For any of the above treatments it is advisable to try the treatment on 3 or 4 birds to test its safety and efficacy and then give to the rest of the flock.

A. ROUND

(ii) *Other roundworms*

Serial No.	Name of the parasite	Synonym	Description	Host	Location	Life-history
1	*Syngamus trachea.*	The gape worm.	The male is about 1/4 in. and the female is about 1/2 in. to 3/4 in. long. They are reddish white in colour and the male is constantly attached to the female forming a "Y".	Chicken, turkeys, etc.	Respiratory system, usually found attached on the surface of the windpipe.	Direct. Eggs are coughed up from the wind pipe, swallowed and passed out in the droppings. Outside these eggs develop and some of them hatch and are swallowed by fowls and turkeys. Within a week the young worms reach the lungs and in another week or 10 days they reach the wind pipe. Earthworms may pick up the eggs in the birds' droppings and act as mechanical carriers.
	Oxyspirura mansoni.	Manson's eye worm.	It is slender, colourless and about 3/4 in. long. It is not common in India.	Chicken and turkeys.	It is found under the nictitating membrane of the eye and can often be detected by a firm pressing of the tear sac at the inner canthus of the eye, when they wriggle out over the eye-ball.	Indirect, cockroaches being the intermediate host. Eggs having been washed down the tear ducts are swallowed, passed out in droppings and taken up by cockroaches.

WORMS—*contd.*

Symptoms and lesions	Prevention	Treatment
Worms clog the wind pipe of chicks which open the beak and gape. There is convulsive shaking of the head, with a hissing cough. Continuous effort to obtain air prevents the chicks from feeding. This and also the fact that these worms are blood suckers weaken the chicken. They become thin and pale and may die of suffocation or general weakness. Turkeys do not show any symptoms in spite of harbouring the parasite and may spread the infection to young chicken.	1. Raising young chicken entirely separate from turkeys. 2. Select a dry sandy soil for young chickens to run on, since such soil is unfavourable to earthworms. 3. Young chicken should be shut up until the dew has dried off in the morning when most of the earthworms which come to the surface will have disappeared	None of the medicinal treatments tried so far has proved useful. Mechanical removal of the parasite by inserting a small quill feather, which is stripped off its barbes well except a small tuft at its tip, into the wind pipe with a rotary movement and then withdrawn. A loop of horse hair can be used in the same way. A little kerosene or oil of turpentine put on the feather will aid in loosening the worms and will also cause the chick to sneeze or cough afterwards and thus help their expulsion.
Continuous winking of the eye, rubbing the head on the feathers of the wing, or scratching at the eye with the foot, defective eyesight, puffiness around the eye, discharge from the eyes and nose, and later ends in severe inflammation and blindness.	1. Removal, from the chicken yards and houses, of all unnecessary objects which may serve as hiding places for cockroaches. 2. Daily collection and removal of birds' droppings to a place where cockroaches cannot get at them.	Apply a local anaesthetic to the eye and then lifting the nictitating membrane of the eye place 1 or 2 drops of 5 per cent creolin solution and wash it with clean water. The worms will have been promptly killed. Boric acid lotion (2 per cent) may be used afterwards to alleviate the inflammation.

B. Tapeworms (Plate III, fig. 4)

Serial No.	Name of the parasite	Description	Location	Life-history	Symptoms and lesions	Prevention	Treatment
1	*Choantaenia infundibuliformis.*	It is about 2 to 8 inches long with bell-shaped segments.	Intestine .	Indirect, with snail, earthworms, fleas and house fly as intermediate hosts.	(See under round worms of the digestive tract.)	(See under round worms of the digestive tract.	There is no cent per cent sure treatment found as yet especially for the microscopic tapeworms which burrow deeply in the mucosa and are not easily attacked by the drugs. However, anyone of the following treatments may be applied with advantage :— (1) One gramme of kamala for an adult fowl given in the form of a pill or capsule is quite effective. No previous fasting or subsequent purgation is necessary. Since it is a poisonous drug it is advisable to test the safety of the dose first on a few birds. (2) Drench the birds in the morning with 2 to 4 drachms of a mixture of turpentine oil and olive oil in equal quantities, after fasting them the previous morning and giving in the evening one teaspoonful of Epsom salt dissolved in warm water and mixed with the mash, to each bird. Three or four hours after the administration of the dose of turpentine oil mixture, give another dose of Epsom salt as before. The treatment may be tried first on a few birds and then given to the rest of the flock.
2	*Davainea proglottina*	The so-called microscopic tapeworm, usually found to consist of 3 or 4 segments, other segments having become detached at a very early stage. It is about 0·5 to 3 millimeters long.	Small intestine.	Indirect, with flies, other insects and slugs as intermediate hosts.	Do. .	Do. .	
3	*Amoebotaenia sphenoides.*	It is about 2 to 4 millimeters long.	Intestine .	Indirect, with earthworms as intermediate hosts	Do. .	Do.	
4	*Raillietaenia cesticillus*	It is about 1/5 to 5 inches long and contains a comparatively large number of segments.	Do.	Indirect, with house fly as intermediate host.	Do. .	Do.	

5	*Raillitaenia echinobothrida.*	It consists of a large number of segments and is usually upto 6 or 7 inches long.	Do.	Indirect, with snail as intermediate host.	Do.	Do.	(3) Same as No. 1 for the round worms of the digestive tract. (4) Carbon tetrachloride or tetrachlor-ethylene in doses of 1-2 c. c. administered with about 3 c. c. of liquid paraffin by means of a syringe and 10 c. m. of narrow rubber tubing which is pushed in to the oesophagus. No previous fasting or subsequent purgation is necessary. In cases of acute enteritis this drug is contraindicated. The safety of the dose may first be tried on a few birds.
6	*Hymenolepis rustica*	It is a small tapeworm about 1/6 to 1 inch long.	Do.	Indirect, with stable fly and other insects as intermediate hosts.	Do.	Do.	

Out of the poultry trematodes (flukes) a small-sized fluke, *Prosthogonimus indica* Sriv stava and another, *Catotropis indica* Srivastava, have been reported from India, infesting the oviducts and the caeca of fowls respectively and causing inflammation of the infested parts. The intermediate hosts for the former are a mollusc and a draggon fly but for the latter nothing has been found as yet. No treatment is available for the one infesting the oviducts but for the other the same treatment as recommended for the intestinal round and tape worms may be applied.

Two other flukes, *Philophthalmidae* species and *Collyriclum faba* which are parasitic in the conjunctival sac of the eye and the skin of fowls, respectively, in other countries have not yet been reported from India.

POULTRY MITES AND LICE

A. MITES

Serial No.	Name of the parasite	Synonym	Location and habits	Characteristic symptoms and lesions	Treatment and prevention
			(i) *External mites*		
1	*Cnemidocoptes gallinae* (Plate IV, fig. 1)	Depluming mite	Back, tail, head, neck and other parts of the body	Abundance of epidermic scales, feathers break off, skin denuded and a little thickened.	Isolate the infected birds. Wash the affected parts with warm soapy water and allow them to dry. Then apply an ointment containing— Sublimed sulphur . 2 parts Potassium carbonate . 1 part Lard . . . 8 parts *or* Oil of Caraway . 1 part Vaseline . . . 5 parts The poultry houses and their equipment should be kept clean and occasionally disinfected.
2	*Cnemidocoptes mutans*	Scaly leg mite	From tarsal joints to toes The mite burrows under the skin, causing enlargement and roughness.	White powdery matter elevates the scales on the legs and rough crusts form (Plate IV, fig. 2). In severe cases lameness results from inflammation of the joints.	Ditto.
3	*Lyponyssus bursa*	Feather mite. (Tropical mite).	They remain on the birds practically all the time and occasionally they are found on detached feathers in nests. It is commonly seen around the vent, but it may be found anywhere among the feathers, and is very resistant to cold and starvation.	The adult mites look like black specks and when they come out on the feathers of a badly infested bird on a sunny day they make it look as if sprinkled with pepper. They suck blood and when in large numbers and birds left untreated the latter become very droopy and may even die.	Thoroughly clean the chicken houses, remove and burn the litter and spray with one part of coal oil and four parts of crude oil. The oil should be allowed to soak into the wood before the birds are returned to the house. Treat each bird by dusting with powdered sulphur. The addition of one part of sodium flouride to four parts of sulphur makes the mixture effective for lice also.

A. Mites—*contd.*

Item No.	Name of the parasite	Synonym	Location and habits	Characteristic symptoms and lesions	Treatment and prevention
			(i) *External mites*—contd		
4	*Dermanyssus gallinae* (Plate IV, fig. 1)	Common poultry mite. (Red hen mite).	It hides in cracks and corners during the day and attacks the fowls at night for drawing blood. Occasionally some mites remain on the birds during the day.	In heavily infested houses, fowls become droopy and listless.	Thoroughly clean the chicken houses, remove and burn the litter and spray with one part of coal oil and four parts of crude oil. The oil should be allowed to soak into the wood before the birds are returned to the house. Treat each bird by dusting with powdered sulphur. The addition of one part of sodium flouride to four parts of sulphur makes the mixture of effective for lice also.
			(ii) *Internal or deep seated mites*		
5	*Cytoleichus (cytodites) nudus.* (Plate IV, fig. 1).	Air sac mite .	Trachea, lungs, air sacs, hollow bones and the peritoneum. (Recently recovered from a number of fowls at this Institute). From trachea they may be expelled during coughing.	Colonies of mites live in air passages of hollow bones. Usually do not appear to be harmful, but they may sometimes produce lung and intestinal lesions and cause death. On *post mortem* examination mites are found as white specks scattered all over in the thoracic and peritoneal cavities and the internal organs.	No specific treatment or method of prevention is known. General measures of control, described previously, may be applied.
6	*Laminosioptes cysticola*	Connective tissue mite.	Subcutaneous connective tissue in places where skin is loose, *e g.*, flanks, breast and neck.	It causes irritation and yellowish white nodules which may be soft or calcarious, are formed under the skin. Mostly it is seen in old fowls in poor condition and apparently does little harm.	Ditto.

B. Lice

Serial No.	Name of the parasite	Synonym	Location and habits	Characteristic symptoms and lesions	Treatment and prevention
1	*Lipeurus heterographus* (Plate IV, fig. 3).	Head louse	It is nearly 1/10 in. long, dark grey in colour and is most injurious to young chicken; found on the top or back of the head, behind the ears and under the bill. It does not run rapidly on the skin and is usually seen on the down or feathers with head close to the skin and body sticking out like that of a tick.	Causes loss of weight and great annoyance to the bird, reduces egg production and lowers general vitality. Lice flourish more rapidly on unhealthy birds.	Treatment and prevention are on the same lines for all the three lice. Sodium flouride is highly recommended by most authorities and it can best be applied by the pinch method, which consists of placing on the skin of each fowl approximately twelve pinches (the amount held between the thumb and forefinger) of finely powdered commercial sodium flouride distributed among the feathers by running the fingers through them on the breast, each thigh, below the vent, on each side of the back, on the neck, the head, and one on the under side of each outspread wing. Care should be taken to cover every part. The excess powder is caught on a newspaper or tray and re-used. Being an irritant drug care should be taken to prevent inhalation or contaminating fowls' food and water. The fowls should be released outside as soon as dusting is accomplished. Hands should be washed carefully after handling the powder. It not only kills all the lice that are present, but it remains in the feathers sufficiently long to kill any that subsequently hatches from the eggs. However, a second dressing within about a fortnight is recommended.
2	*Menopon biseriatum* (Plate IV, fig. 3).	Body louse. (Crawling louse).	It is rather large in size and is of a pale straw colour in which are some dark spots due to food contained within the digestive tract. It prefers the skin, particularly of those parts which are less densely feathered and rarely found on the feathers. It is commonly found on chicken, just below the vent and runs rapidly over the skin in search of protection if feathers are parted. The eggs are deposited in clusters at the base of the feathers especially below the vent where they sometimes collect in large numbers. Eggs hatch in a week and reach maturity in 17—20 days.	Ditto	

B. LICE—*contd.*

Item No.	Name of the parasite	Synonym	Location and habits	Characteristic symptoms and lesions	Treatment and prevention
3	*Goniocotes hologaster* (Plate IV, fig 3).	Fluff louse . .	It is very small but broad, and is pale in colour, with translucent appearance. It is found on the fluff of the feathers of various parts of the body, especially those where feathers are fluffiest and shows little activity.	Causes loss of weight and great annoyance to the bird, reduces egg production and lowers general vitality. Lice flourish more rapidly on unhealthy birds.	One ounce of commercial sodium flouride dissolved in a gallon of tepid water can be used for dipping the birds in warm weather when they will be dry before sunset. Each bird should be kept under the fluid for about half a minute ruffling the feathers to let the liquid in and ducking the head once before taking it out to drain. Dusting boxes containing road dust or fine coal ashes to which some lice powder is added should be used to treat all new birds before adding to the flock. Infestation is always worse in dirty and neglected houses, runs and roosts which should be kept clean. The whole life cycle is lived on the birds so that after destruction of lice reinfestation will not take place from the house.

The common poultry tick, *Argus persicus*, has already been dealt with under fowl spirochaetosis.

There are a number of contagious, parasitic and nutritional diseases of poultry which have been overlooked in the past and are yet to be identified in India, but even about those which are known to exist a good deal has yet to be learnt regarding their incidence, epizootiology and control.

My thanks are due to Messrs. J. S. Rao and Ahmad Bux, Artists of this Institute, for the illustrations.

THE NEW LYALLPUR HOE (*TRIPHALI*)

BY

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UNLIKE other countries where different implements are used for shallow and deep cultivation, *desi hal* is generally employed in India for all classes of soil and all conditions, which results in a waste of a good deal of time and of man-and bullock-power. For shallow cultivation other implement which would cover more land in a given time and does not go so deep as *desi* plough may also be used with advantage.

Horse hoe (*panjdanta*) is the best implement for shallow cultivation but it is costly and most of the cultivators cannot afford to buy it.

The New Lyallpur hoe (*triphali*) consists of three tines attached to an iron frame on which a wooden handle and a long beam are fixed (Plate V). It. is a simple, cheap and fairly good substitute for Horse hoe (*panjdanta*). A comparative test of this new implement was made against *desi hal* and Horse hoe in a moist loam soil. The results are given below :—

	New Lyallpur hoe	*Panjdanta*	*Desi hal*
Average depth in inches	3·4	2·8	5·1
Average width covered per furrow—inches	15·5	28·0	8·8
Average working draft in lbs.	191·5	236·3	184·8
Approximate time required for covering an acre in hours when bullocks walk @ 1¾ miles per hour and stoppages are excluded.	3¼	2¾	5¾

These figures show that the Lyallpur hoe is midway between the other two implements, though the difference between the draft of *desi hal* and the new hoe is only of 7 lbs.

The new Lyallpur hoe (*Triphali*)

The Lyallpur hoe is useful for the following operations :—

(1) At the time of the preparation of seed-bed land is usually ploughed twice or more with *desi hal*. The cross cultivation (*dohar* and *tehar*) can be done in approximately half the time if the new Lyallpur hoe (*triphali*) is used for the purpose. A better seed-bed would be prepared with the same labour and in the same time as used with *desi hal* if Lyallpur hoe is used in conjunction with *desi hal*. It would result in better germination of crops.

(2) After rain and after irrigation in summer in the canal colonies, land has got to be tilled before it gets too dry. This cannot always be done if a farmer uses only *desi hal*. On the other hand, he can do so if he uses the new Lyallpur hoe instead of *desi hal*.

(3) It is very useful for interculture of cotton sown in lines.

(4) Small seeds such as *toria* (*Brassicae campestris*) can be mixed with soil efficiently by the new Lyallpur hoe.

It can be had from the Deputy Director of Agriculture, Punjab, Lyallpur. Its price is Rs. 5-2-0.

It is easy to make this hoe locally.

Only good hard iron should be used for its construction.

FURTHER RECORD OF THE OCCURRENCE OF CODLING MOTH IN INDIA

BY

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About two years ago the writer reported [Pruthi, 1935] the occurrence in Baluchistan of the notorious Codling moth—a very serious pest of apples, pears, etc. in America, Europe, Africa, Australia and other apple-growing parts of the world. This was the first definite record of the pest from the Indian Empire. Last year I received some damaged apples from the Assistant Director of Agriculture, Peshawar Circle, for the identification of the pest concerned. It appeared that the damage was partly due to the attack by the caterpillars of Codling moth. As the consignment did not actually contain any specimen of the pest one could not be sure of the presence of this pest in North-West Frontier Province. Recently, Mr. H. N. Batra, Entomological Assistant of that province sent me for naming a large collection of the insect pests of fruit of his area. The collection has been studied at New Delhi and is found to contain some specimens of Codling moth, which are stated to have been bred from apples at Parachinar during June-July, 1936. In his note accompanying the collection Mr. Batra has reported that this insect, which he calls 'apple fruit borer' causes serious damage to apples and pears at that locality. To quote his exact words "the borer has been found at Parachinar, damaging apple fruit to an alarming extent, especially in Shallozan. An orchard of about fifty trees which used to yield 200 maunds of apples some time ago is now left with hardly 20 maunds of fruit due to this borer". In August 1937 the writer himself found the pest occurring in large number at several localities in the Parachinar district. It is therefore certain that Codling moth occurs in the North-West Frontier Province and is probably a pest in certain localities.

The Imperial Council of Agricultural Research has recently sanctioned a scheme for the survey of the insect pests of fruits in the North-West Frontier Province and it is hoped that the survey party will determine the exact distribution of Codling moth and its status as pest.

From the occurrence of this pest at Parachinar, near the Afghanistan border, it would appear that the record of this species from Dras Ladakh (Kashmir) considered by Fletcher (*Proc. 2nd Ent. Meet. Pusa*, 1917) to be possibly founded on

a mistaken identification was probably accurate and that Codling moth occurs in North Kashmir also. The apple-growing tracts of the Punjab (Kulu, Simla hills), the Kumaon and other high hills in the eastern part of the United Provinces also require to be carefully examined.

It may also be reported that last summer (1936), when touring in Baluchistan, the writer saw some apples reported to have been imported from Kandahar (Afghanistan) which were infested by the caterpillars of Codling moth. This year also some apples from that locality were examined at Chaman by one of the writer's assistants and were found to have been damaged by Codling moth. It therefore appears that this pest is widely distributed in Afghanistan (from Kandahar up to, if not beyond, the districts bordering on Parachinar), and has not been reported in scientific literature so far, probably because the area has not been explored from entomological view-point.

REFERENCE

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A NEW DEVICE TO CHECK SELF-POLLUTION IN COWS

BY

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INTRODUCTION

SELF-POLLUTION in cows is a vice which can be defined as an endeavour on the part of the cow to suck her own teat to drink the milk. It is absolutely an acquired vice which later on becomes a habit and appears to be guided by sudden impulses. As a result of this, the cow loses affection for the calf and consequently the poor calf, if left uncared for, gradually dies of starvation.

Allowing the heifer to suck the mother-cow for a long time and certain shortcomings in the principles of rearing calves and grazing herds appear to be responsible for such cases. In places where the writer had to serve, he found that no less than two or three per cent of good milkers suffer from this vice. The veterinary surgeon is very often called upon to remedy this defect.

Referring to the available veterinary and dairy instruments' list we fail to find any guidance in the matter. The writer has so far not come across any instrument meant to check this vice and also failed to find any existing literature on the point. Hence he had to fall back on the indigenous means in existence.

The means commonly adopted by villagers are as follows :—

(*i*) *Applications.*—Powdered *neem* leaves, earth, cowdung, quinine, etc. are made into pastes and applied to the udder. But the craving of the animal for milk is so great that applications of any kind are not cared for, and within an hour or so the animal licks it out. The application is then of no use.

(*ii*) *Thaili.*—Cloth, gunny bag, canvas bag, are tied as protections to the udder. The animal very easily tears off these bags, even those of leather, for the sake of milk and persistent attempts to watch the animal prove to be of no use.

(*iii*) *Dava.*—The animal is tied up with short ropes and fastened on both the sides. Of course this method allows very little chance for the animal to drink milk, but in the persistent attempts to reach the teat it generally falls down in the manger and injures itself. The cow has to be kept within doors for twenty-four hours and needs a careful watch.

Apprehension of the danger of the animal being injured, need of ceaseless vigilance, and the inconvenience caused to the animal go to discourage the owner to employ this means.

FIG. 1 Cow drinking its own milk

FIG. 2 Cow tied with chains. In this the animal easily drinks milk. If a third rope is attached to the neck and tied to the post it becomes *dara*. The calf is standing with *chimta* on the face to disable it to drink the milk of its mother. (The calf belongs to some other cow but has been shown here to demonstrate the use of *chimta*, which is also employed for the cows to prevent the vice)

FIG. 3 Cow with *mohaila*

(*iv*) *Chimta.*—Two pointed bamboo sticks are tied crosswise over the nose of the animal. The animal safely removes it and enjoys its milk. If the *chimta* is tied too fast it is a hindrance for the animal in grazing to some extent, and injures the skin of the abdomen or the udder.

(*v*) *Moharka.*—A head-collar fitted with pointed nails on the nosepiece and check-strap is put on. In this the animal gets injured at the udder, fails to drink the milk but the tongue reaches the front quarters and stimulates the supply of milk. As such, there appears a voluntary dribbling of milk and hence the owner does not profit by the use of the appliance.

(*vi*) *Mala.*—A cradle made of bamboo sticks and tied round the neck. If properly made is less injurious but the animal still manages to reach the udder and causes the wastage of milk by thus stimulating the secretion. If the ropes break, and this the animal manages easily, very little is to be expected by the owner. In extreme cases putting even the best possible cradle and even a strict vigilance never paid the owner as tried by the writer himself. The above-mentioned methods proving futile, a new method had to be thought of which would avoid inconvenience to animal and check the abominous vice with least trouble and expense on the part of the owner.

Experimental

In Betul the writer came across for the first time a cow addicted extremely to this habit. Best and persistent attempts, at all the methods and appliances known, proving futile, the writer was inspired to tackle this problem.

Observing several other cases and studying various postures that made it possible for the animal to suck her own teats it struck the writer, that if an adequate barrier between the lips and teat be designed for constant use it may without interfering with the natural requirements of the animal remedy the defect. Taking in view the facts a card disc with a notch on one side was designed and was fitted to the septum nassi. It was a matter of pleasure to notice that the said measure gave encouraging results.

The card-board disc had to be constantly guarded against getting loose and falling off, and had to be regularly changed. It used to get wet by the nasal discharge and drinking water, and once soft, it had to be changed.

The card-board was then substituted by a tin disc which had its own disadvantages in that it resulted in injuries to the nostrils and to the septum nassi, and tin easily bent this way or that, and it was difficult to keep it in proper position for a long time. Therefore a similar disc of iron had to be made and after boring the septum it was kept in position. This gave the desired result but the making of a hole was considered unwelcome by the villagers and its injuriousness made me think like that too. Aluminium disc with clips to hold was lighter and was hence substituted for the iron one. But the clips were too hard to be worked

up and down with facility. After several unsuccessful attempts the writer finally succeeded in devising an adequate device which fulfilled ordinary requirements and which has been giving extremely successful results in all the cases available till this time. The details of the design are given below.

The clip is pressed open and put into the nostrils with a slight jerk and is kept in this condition constantly. Once the clip is fixed no skill but a little attention is needed. While feeding the clip remains on the food and while attempting to drink milk it remains below the teats. Cows of nervous temperament do show some excitement but they should be encouraged to get accustomed to it. If they go off feed one should provide tempting feeds in abundance and shall leave the cow alone. Within a period of thirty-six to forty-six hours the animal resumes the normal temperament after which a few drops of oil should be applied on to the clip and the nostrils. After the use of this particular appliance at times the cow begins to decrease a little in her milk yield owing to the fact that even the presence of the calf does not stimulate milk secretion because of the animal being accustomed to secrete it by licking it with its own tongue. Gradually the milk supply is restored but in certain cases the owner has to be contented with whatever quantity of milk is available. During the next calving if the clip is put on immediately after the event and allowed to remain on, the milk supply resumes to its normal. The cow then forgets gradually the bad habit. Cows which have lost their calves and are for more than three months standing in milk get dry and then conception soon follows.

The use of the clip should be discontinued during the dry period.

There being any fear of the clip being removed by cow-boys while the animals are out in the *jungles* a screw may be fixed on in the hole with the blade of a knife.

As a caution it may be mentioned that the above measure may and does show some disappointing symptoms in the beginning such as salivation. These are no matters of any frightful complications, and the above method, though slower than the others in showing signs of success, is undoubtedly steadier and as such is sure to win the race.

SUMMARY

The malady has been observed even in good milkers. The calves are born healthy, but in no less than ninety per cent of the cases they die perhaps of starvation for hand feeding of calves is rarely practised in the villages. Existing methods do not assure satisfactory results and are either painful to the animals or inconvenient in their adoption.

In certain parts self-pollution in cows is regarded as ominous and the owners generally get rid of such animals, which in their turn after changing hands ultimately reach the slaughter house or the *gorakshan*.

A light aluminium disc clipped into the nostrils of the animal is an adequate device, which is simple, safe and is a sure means of checking the vice and is the best and the most convenient of all crude ones in use.

Remarks

Considering the economical and philanthrophic points of view a new device has long been due but owing to the quick passing of such animals from hand to hand and reaching the slaughter house or *gorakshan* early in their life very few of the veterinary surgeons might have had any opportunity of coming in closer contact with such animals. Therefore it is no matter of surprise that the problem remained unsolved.

Conclusion

Nothing will please the writer more than to hear of a universal and successful use of his device. The writer welcomes any suggestion, correction, addition or modification proposed and assures the best of his attention in the matter.

Besides, those who are paid to look after such matters it is really generous of those who voluntarily give their valuable services in the cause of the helpless and dumb animals. The S. P. C. A., Nagpur really deserves all praise and credit for its efforts in a right cause as this and as a mark of reverence I dedicate, with its kind permission, the present paper to the said society and also shall I name the clip " Shoobert Safety clip ' for prevention of self-pollution in cows ' " in honour of the worthy President of the said S. P. C. A., who is a real friend of the animals and an inspiring force in the Society.

Acknowledgments

My thanks are due to Mr. J. Ramdas, Barrister-at-law, the Honorary Secretary of the Society and the Hon'ble Mr. Justice W. R. Puranik, the Secretary of the Gorakshan, for their inspiring encouragement and kind co-operation.

The Secretary of the Gorakshan very kindly tested the instrument, and provided me with photographs gratis, for which he and the Manager of the Gorakshan are particularly to be thanked.

My thanks are also due to Dr. P. S. Nair, Assistant Director, Veterinary Services and Mr. Gokhale, I.D.D., for their valuable advice and guidance in this connection.

OBSERVATIONS ON CATTLE DIPPING, AT THE IMPERIAL CATTLE BREEDING FARM, KARNAL

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Introduction

The damage done by ticks to cattle is not as much realised by Indian stock-owners as by those in other tropical countries. Ticks are harmful to cattle, sheep and other live-stock as they run them down in condition due to their blood-sucking habits. They are also responsible for the spread of diseases like Red Water or Tick Fever. Due to their habit of attaching themselves to the host in such awkward places as the ears, root of the tail, etc., they are difficult to remove by the ordinary method of brushing. Some skin dressing has, therefore, to be applied to bring about their destruction. To facilitate this work and in order that the dressing may be uniformly and effectively applied, dips or swimming baths have been introduced. By these, it is aimed to keep the ticks, attached to the body of the animal, immersed for a few seconds in a solution of arsenic, as the animal is dipped or as it swims through the dip. As ticks are very commonly found in village cattle and as the well-bred herd at the Karnal Farm came in contact with such animals due to the peculiar conditions prevailing at the Farm, dipping had to be resorted to to check the infestation. Further, the animals used to pick up ticks from the pastures in low-lying places.

Design of the dipping tank

The dipping tank at the Imperial Cattle Breeding Farm at Karnal was first built in the year 1932-33 and after experience was gained it was further modified in the beginning of 1933-34.

The dipping tank or vat as designed (Figs. 1 and 2) consists of three sections; (1) the approach, (2) the dipping vat and (3) the exit or draining floor. The approach is connected to the cattle crush where all the animals for dipping are collected first. The approach is protected on the sides by railings with a floor space

just enough for one animal to pass which prevents its backing at the sight of water. The vat is constructed to the requirements of the kind of stock to be handled. The entrance slopes down to a sudden drop which helps a complete dipping of the animal as it is compelled to jump from the walk end. The animal then has to swim a length of about forty feet through the dip, which has an exit with steps for the animal to walk out conveniently. The draining floor, where the animals are again collected for draining off before they are let out, is sloped in such a way that all drippings are returned to the tank to prevent wastage of the chemical.

PLAN OF CATTLE DIP

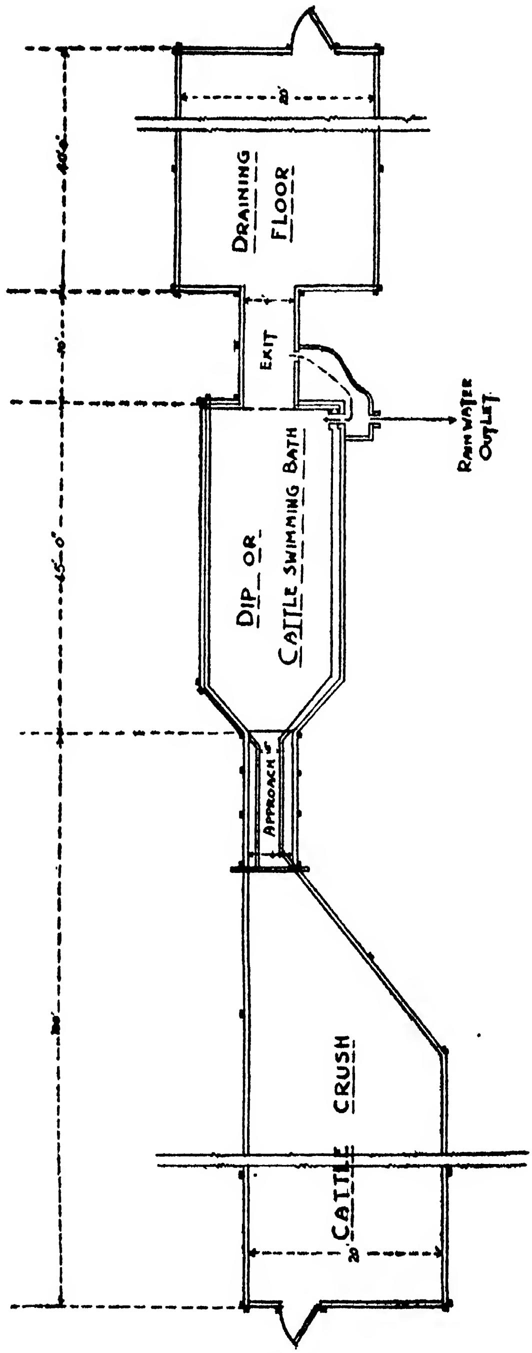


FIG. 1.

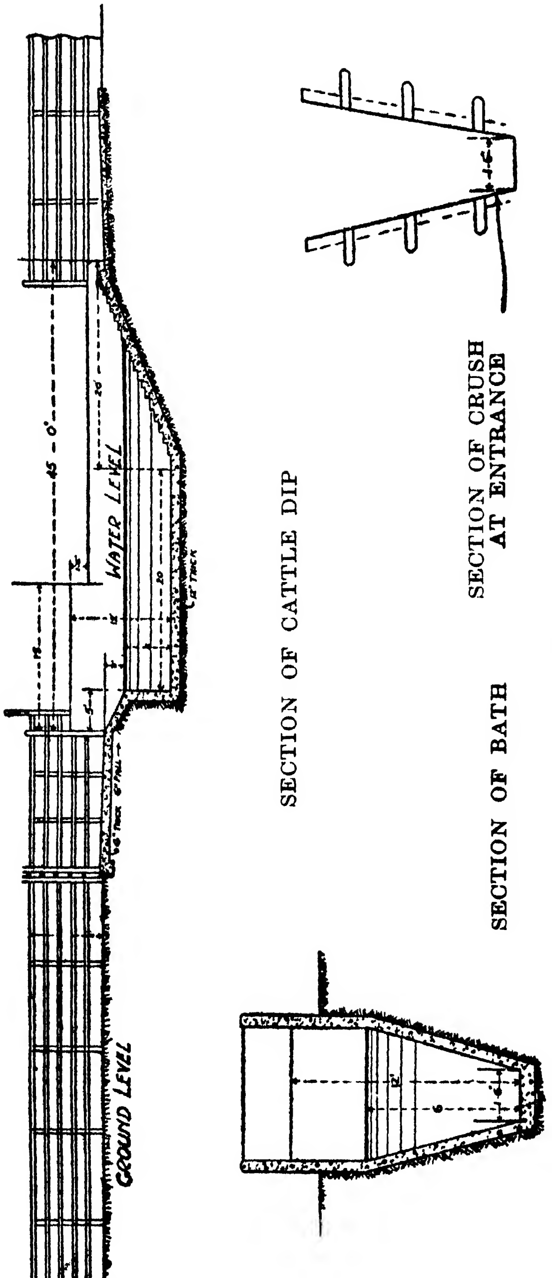

SECTION OF CATTLE DIP
SECTION OF CRUSH
AT ENTRANCE
SECTION OF BATH
WATER LEVEL
GROUND LEVEL
45 - 0'

FIG. 2.

Line of work.—The intensity of the trouble with the ticks at the Karnal Farm varied with the season. It was observed that they first made their appearance early in March, increased in numbers till about July and then appeared to decrease in number just after the rains and kept up till about November. During winter they were found in negligible numbers. Though dipping was started in November 1933, a systematic record of the observations was started from 1934. The observations were made on the following lines :—

(*a*) Number of cattle dipped.

(*b*) Corrections at each dipping.

(*c*) Total cost of dip consumed.

(*d*) Effects of dipping on ticks and skin.

SOLUTION FOR DIPPING

The chemical used was "Cooper's cattle stock dip solution" to a strength of 1 in 150 for a fortnightly dipping. In sixteen turns which were given during the period of study from January to December 1935 a total number of 6,000 animals passed through the dip. In the beginning it took more labour and time to get the animals dipped than at the later stage when the animals felt accustomed to it. All dipping was done on hot sunny days only. To get the best results from dipping the correct strength of the dip was required to be maintained and this was determined by the iodine testing outfit which was provided by the manufacturers of the dip.

Under field conditions the causes which commonly give rise to the variation in the correctly made dip are :—

(*a*) Entry of water due to rains and leaky taps, resulting in decrease of concentration.

(*b*) Evaporation of water from tank leading to an increase in concentration.

(*c*) Chemical changes producing an apparent increase or decrease in the initial concentration of the dip. Such chemical changes are primarily caused by micro-organisms present in tank fluid. Some types are capable of oxidizing the arsenite to arsenate and others of reducing arsenate to arsenite.

Such a dip is spoken of as oxidized. Oxidation may occur in any tank but is more common in tanks through which only a few animals pass or which are idle for a long period. In such cases where oxidation has occurred it may be reduced by adding to the tank fluid some organic matter such as fresh cattle dung. The correct determination of the concentration of the dip is of primary importance each time the dip is to be given. If the concentration is low, the good result expected from dipping cannot be obtained. On the other hand if it is too high serious damage may occur through the scalding of the stock. The latter most

commonly happens when the dip is of over-strength. But stock may also be scalded after immersion in ordinary concentration if the dipping is done on a cloudy sultry day, *i.e.* when such conditions exist that the drying of coat takes place only relatively slowly and, therefore, dissolved arsenic remains for a long time in contact with skin. When initiating, it is, therefore, advisable to start with a fluid considerably under-strength, and gradually increase it over a period of six to eight weeks till the desired strength is obtained. When previously dipped cattle have not been dipped for some time the interval for the first two or three immersions may be increased. This fact is particularly to be considered in fourteen-day concentration. Avoid dipping under weather conditions which favour slow drying. Scalded animals should not be dipped until the skin is completely healed. Appendix shows the shrinkages and corrections at each dipping. No laboratory tests were made to ascertain the total arsenic in the fluid, but only the usual Iodimeter test was carried out. In view of the fact that the animals dealt with at the Farm were rather tall (tallest measuring 5 ft. 5 in. upto withers) a fairly high level of fluid in the tank had to be maintained. The initial depth of the fluid was 7 ft. 6 in. equivalent to 7,200 gallons in cubic contents. To begin with forty-eight gallons of the dip solution at a cost of Rs. 376-6-0 were used and a further five gallons were used during the year for corrections costing about Rs. 13-3-0 or a total of Rs. 389-9-0 for the year.

Precautions to be taken

The following precautions are suggested before dipping :—

(1) The fluid in the vat should be thoroughly mixed before sampling for tests.

(2) Animals should be watered before driving them into the dip. Thirsty animals are inclined to take the dip after jumping and this leads to serious results as the dip being of arsenic is very poisonous.

(3) Animals very near calving, animals newly calved and calves below the age of eight weeks should not be passed through the dipping vat as the sudden jump in the dip is likely to give them shock. These can be sprayed on the draining floor itself.

(4) Avoid dipping in cloudy and chilly weather.

(5) Udders of milking animals that have passed through the dip must be wiped out well before milking to remove traces of arsenic which is likely to dry up on the udder.

(6) Dipped animals should not be passed through clean water for two or three days after dipping as the effects of the dip are otherwise lost.

(7) Animals in heated condition (after active work) should not be dipped. A rest of at least three hours must be given before and after dipping otherwise serious complications in the lungs are likely to arise.

(8) All drippings from the dipped animals must cease before the animals are let out of the draining floor, to avoid contaminating pastures with arsenical matter.

(9) While dipping calves care should be taken to render help to animals in trouble. This can best be rendered by providing two forked rods as per Fig. 3.

DIAGRAM OF
FORKED RODS

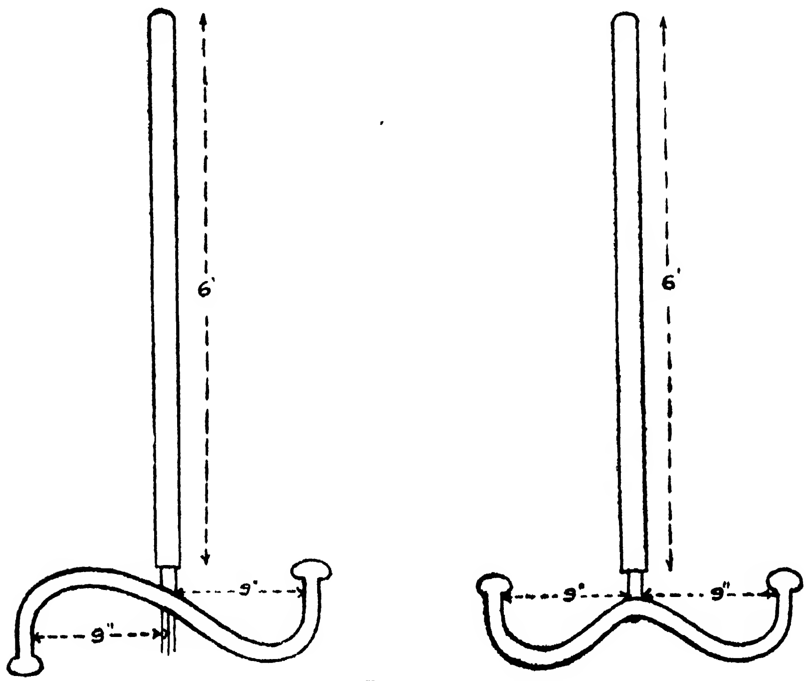


FIG. 3.

(10) The used up dip when being emptied must be thrown in fenced are not accessible to cattle and sheep.

OBSERVATIONS

(1) Dipping had little or no effect on full-grown ticks but the effects could be noticed on young ones which were destroyed, thus reducing their number. Once it was noticed that when dipped animals were sent out to a pasture full of ticks, the ticks attached themselves to the inner side of the eyelids of the animals where the dip had not penetrated.

(2) The coats of dipped animals attained a glossy and healthy appearance soon after dipping and maintained the same for a number of days.

(3) Dipping helped in eradicating the ringworm in calves which is practically non-existent now. A bullock with persistent skin affection responded more readily to dipping than to any other mode of treatment and there was marked improvement in its coat.

(4) During the fly and mosquito season the cattle obtained great protection from them by dipping. Where these inseots had bitten or sat on the dipped animals they were killed and they were found lying in the vicinity of the dipping vat.

(5) In the beginning the dipping indicated a few drawbacks. Accidental injuries were caused to animals due to their stampeding, but this trouble was overcome by their careful handling and their getting accustomed to the dipping. Male stock took more readily to dipping than females. Some drop in milk yield in the case of milch animals was also noticed the day following the dipping, probably due to excitement during dipping but this was more than compensated for by a sudden increase immediately after. The drop was from ½ to 6 per cent . Deaths due to drowning and swallowing of arsenic solution may occur more often in calves. But this can be prevented by regulating the entry of animals into the vat and avoiding their jumping over one another. Only one casualty occurred in a calf, six weeks old and the death occurred after a lapse of three weeks from lung trouble. Sheep did not take to dipping well. It caused dullness and indisposition in a majority of them.

(6) The use of the dip must be stopped when the fluid gets a dark muddy appearance and when it adheres more thickly on the coat due to excess of foreig matter such as manure, dirt, etc.

Conclusions

Dipping was found to be greatly helpful for a large herd to be kept in healthy and good condition.

It improved the coat of animals and helped in eradicating skin diseases.

It reduced the ticks and afforded some protection to the animals from biting flies, mosquitos, etc.

This can best be used by small stock-breeders on co-operative basis.

Acknowledgment

We wish to express our thanks to Mr. Zal R. Kothavalla, B.Ag., B.Sc., Agri. (Edin.), N.D.D. (Scot.), for guidance received and facilities afforded, and to Mr. H. C. Verma, I.D.D., N.D.D. (Scot.) for his suggestions.

Appendix

Date	No. of animals dipped	Shrinkage		Corrections		Remarks
		Between dipping in inches	During dipping in inches	Dip solution gls.	Water gls.	
11th April 1935 (*a*) .	376	..	2¼	45	..	Initial
25th April 1935 .	378	..	1¾	3	..	Full strength
10th May 1935 . .	435	..	2¼	..	350	
24th May 1935 . .	379	..	2¼	..	350	High winds
7th June 1935 . .	446	1½	2½	..	770	Do.
21st June 1935 . .	387	½	2¼	2	300	Raising the level of fluid.
3rd July 1935 . .	391	¼	2½	..	320	Humid weather
17th July 1935 . .	400	¼	1¾	..	..	
1st August 1935	392	2¼	2¼	..	..	Not tested
16th August 1935 .	391	..	4¼	..	350	
1st September 1935 .	*462	..	4½	2	..	*Two dippings. Entry of rain water
18th September 1935 .	484	..	2½	..	..	
2nd October 1935 .	359	..	2	..	350	
17th October 1935 .	400	..	2	..	..	
2nd November 1935 (*b*)	320	..	2½	1	..	

(*a*) Dipping could not be started earlier due to the dip solution not on hand.

(*b*) Dipping stopped early November due to cold weather. Large variations were due to sheep which were not always dipped due to the wool getting soiled.

Note on the above article by H. W. Walford, Manager, Government Military Dairy Farms, Sialkot.

1. If the lower portion of a part of the approach to the dip were enclosed by cement walls to a height of about two feet on each side, it would prevent obstinate animals putting their legs through the rails or anchoring their feet behind the iron posts.

2. We use a strength 1-200 in a bath containing 5,000 gallons which is large enough for the largest of Friesians.

3. Not more than one of the animals passing through dip in a year are scalded and when scalding takes place it is slight and affects those whose skin is flesh coloured. Leaving them out of the dip and applying a little vaseline occasionally soon results in the burns healing.

4. Our experience is that animals when going through the dip show no in clination to drink but it is a fact that thirsty animals will drink the dip if they can-get at it other than by swimming. There is evidence which leads us to think that only those animals which are new to the place are likely to mistake the dip for a water trough.

5. We dip winter and summer and commence from the age of about three weeks.

6. Dipping gives no apparent freedom from mosquitos or flies nor do we notice any particular glossiness of skin as a result of dipping.

7. Dipping fortnightly over a period does without doubt render animals immune to tick infestation for long periods after dipping ceases (upto two months we have experience of).

8. We change the fluid approximately every 3rd to 4th month as by then it is too dirty and leaves a dangerous amount of scum on the animal.

9. The most sensible summing up of the position as regards oxidation, is contained on page 8 of Cooper's Instructions regarding testing. If cattle are dipped regularly as we do them testing is not important as in any case the most probable fault in a dip is oxidation which it is only possible to register by making a chemical analysis.

Authors' reply to the above note.

1. The suggestion that the lower portion of a part of the approach to the dip be walled is useful.

2. We maintained the strength of 1 in 150 as per original specifications and since we found this strength satisfactory throughout, it was unnecessary to alter

it. For the size of the dip and the level of the fluid we maintained, 7,200 gallons had to be kept up.

3. The number of the scalded animals, as observed by us, was negligible and such scalding was noticed among buffaloes during June and July.

4. The animals may not show an inclination to drink while swimming in the dip but watering them, before driving them in, provides an additional safeguard. To prevent animals gaining access to the dip other than during dipping, it must be well fenced and this was paid special attention to at Karnal.

5. Our experience of Karnal winter did not encourage the dipping to be carried during winter subjecting the animals to a temperature much below body heat.

6 and 7. We found dead flies and mosquitos lying outside the tank and the temporary freedom from these pests thus obtained for the animals helped to cause a small increase in milk yield.

The dipped animals did show improved coats.

8. It would be necessary to change the fluid every three months or so, if the animals dipped are not clean prior to dipping. But at Karnal the animals were always clean as they were made to pass through a tank of clean water almost daily throughout the summer.

9. We consider that in fairness to successful dipping and for acquiring desired benefits from the dip it is absolutely essential to maintain the specified strength in the tank. To know what we are dealing with, we must test the strength of the solution quite often. The manufacturers who must have subjected the Iodimeter Test to much investigational study recommend the same for all field purposes.

NOTES

THE PISTACHIO NUT TREE IN INDIA

Introduction

This nut which is commonly known in India as *pista* belongs to the genus *Pistacia* of the family Anacardiaceae. The genus has some six species. *Pistacia vera* Linn., the pistachio nut, is a small tree found in forests at 3,000 feet and upwards in Syria, Damascus, Mesopotamia and the Khorasan. It is extensively cultivated in Syria, Palestine and Persia. The leaves are frequently affected by galls, irregularly spheroid in shape, borne on a short stalk and usually growing from the surface of the leaves. These with the pericarp of the fruit and the unfertilised ovaries are used locally for dyeing silk, and are exported to Persia, Turkistan and India. The fruit known as the pistachio nut is oval-shaped and varies in size with the amount of cultivation the tree has received. The nuts are exported in large quantities from Afghanistan to India, Persia, and Turkistan. In India the nut is a common article of food among the well-to-do classes, being fried with a little butter and salt and brought to the table hot. The nut is also a frequent ingredient in confectionery and ice-cream. It contains about 60 per cent of fatty oil, which is occasionally extracted for use in medicines. The tree requires very little water and can grow very well even in *barani* land (*i.e.*, land which depends on rain only for irrigation) and *kallar* (alkali) land. If the land is fertile it can be utilised for growing melons, and grape-vines between the pistachio trees during the early stages of their growth. The pistachio flourishes well in Birjand (Eastern Iran) where the temperature varies from 15°F. in winter to 108°F. in summer. The information about its growth and cultivation has been obtained by the Imperial Council of Agricultural Research through the kind courtesy of His Britannic Majesty's Consul for Khorasan and Meshed, and is recorded here with the hope that it may be of benefit to the Agricultural Departments who may attempt to grow this nut. At present there are only a few wild pistachio trees in the hilly tracts of the North-West Frontier Province and Baluchistan.

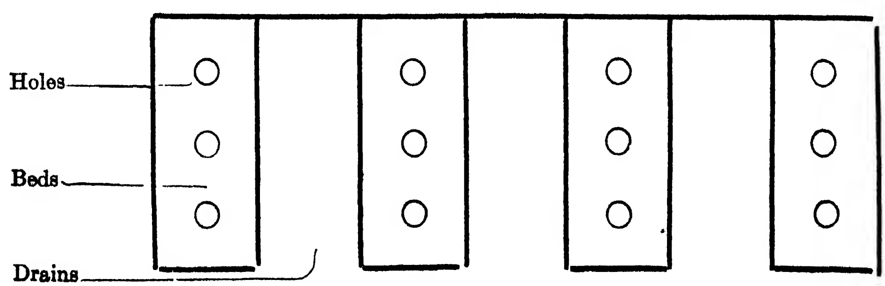
Preparation of seed-bed

The land should first be dug one yard deep and the roots, weeds and stones carefully removed. It should then be levelled and made into small beds. They should be made at a distance of about four yards from one another, each of them being two feet wide and one foot deep. These beds are to be made similar to those which are made in Baluchistan for cultivating musk-melons. In the case of

barani, uneven or steep area it should be dug just as much as is required for sowing the pistachio seeds only. In other words pits measuring one square-yard each should be dug a yard deep in the soil, at a distance of four yards from one another. The pits should be filled up with soft soil free from stones and the seed sown in them in the manner explained hereinafter.

Preparation for sowing seed and early growth

Seeds are prepared for sowing in the spring season, the time varying slightly with the climate of the place, *e.g.* in a warm climate in the first week of March and in a cold by about the 15th of March. Good big pistachio nuts with rich kernel and parted pericarp (*khandan—i.e.* "laughing" as the Persians say) should be selected. The kernel should be visible from the opening of the pericarp but it should be firmly attached to the pericarp and should not shake even when stirred by the finger. It should be carefully seen that the kernels do not move when shaken because a moving kernel will not germinate. In the beginning of March the nuts should be soaked in lukewarm water in a vessel and placed in a room for twelve to fifteen hours. The nuts should then be taken out and put in a gunny bag which is again placed in a small vessel. Water is sprinkled daily on this bag for one week so that the nuts may not get dry inside. In this way the pistachio will germinate in a week's time. When two-thirds of all the seed has sprouted, they should be taken out of the bag and then sown in the prepared beds in hole about 3 inches deep and about 2 feet apart.



Three or four sprouted seeds should be put in each hole and these should be covered with a handful of soft soil. The beds must be separated by channels and watering done at once in these channels after sowing. They should be irrigated simultaneously and care should be taken that the water spreads uniformly. The parts into which the holes are dug should always remain dry and water should not reach them. The roots will draw water from the earth beneath the holes from the sides and the seeds will grow quite satisfactorily with the help of that moisture. On germination the seeds should be watered by hand after every week till the winter of the first year. If weeds begin to grow between the seedlings these should be removed with a pointed sickle or knife. Care should be taken that no injury is done to the tender pistachio plant. It is possible that three or four seedlings may

sprout up from each hole. They may all be kept during the first year but during the second year only one plant per hole should be retained and the rest removed. Watering in winter should be done after every 15 or 25 days and if the soil is already moist, the period of watering may be increased by a few days more according to local conditions. This process should be continued for two years.

Manuring

In the third year the pistachio grows into a fairly strong tree. At this time manure should be applied to it. In Persia, cattle dung is stored in winter in a big pit and water is sprinkled over it occasionally so as to allow it to rot completely. It is ready for use in the middle of March and can then be dug into the soil round the tree. The ground round the roots of the trees is dug deep with a shovel without injuring the roots. One or two shovelfuls of this manure are put into the soil and it is refilled with the earth dug out of it. Well-powdered common salt at the rate of two to three *chhat'aks* (1/8th of a lb.) per tree may also be mixed with manure as it has been found useful in improving the general growth and yield of fruit. If the garden is situated on *kallar* land or in a water-logged area, the addition of salt will be injurious as such soils already contain enough salt. The blood of sheep and goats if available may also be mixed with advantage with the manure.

Irrigation

After the manure is applied the trees should be watered after every ten days during the first month and twice a month thereafter throughout the year. If pistachio has been planted in the *barani* ground no water is necessary after the first year of its growth. The only necessary precautions should be taken for its protection from animals, etc. Winter rains will prove very beneficial but if there has been no rain there is no fear of any harm to the trees. In the gardens which are watered occasionally it will be sufficient to water five-year old trees once a month only in summer. It will not cause any damage to a ten-year old tree if no water is given to it at all. Large quantities of water given in winter are enough to keep the plant in good condition throughout the year.

Grafting

Pistachio plants will be ready for grafting in the third year. The proper time for grafting is the end of May or the beginning of June. In other words one or two weeks before the ripening of the mulberry is the best time for grafting. The beds of the field should be watered one day before grafting so that the plants may remain green and may stand the operation well. The method of grafting is almost the same as of mulberry and apricot. A good fruit-bearing pistachio tree in the locality should be selected for the purpose of grafting. In the case of a good tree being not available these plants should be grafted on one another among themselves. The bud of one plant should be grafted on the other. Pistachio trees are

generally both male and female and only the female trees bear fruit. As it is difficult to distinguish the males from the females among young plants, only one graft will be sufficient in the first instance. In the second year the male and female plants wou'd be distinguishable. Grafts of only female tree will bear fruit although it is necessary to keep a few male trees in a plantation of pistachios. Some trees in every line should be left without graft at some distance. In an average garden two or three male trees will serve the purpose. When the plants are fit for grafting, thinning should be done and a distance of at least two and a half yards should be left between the trees to allow enough space for good growth. After grafting has been done all the fresh branches and leaves which shoot below the engrafted branch should be carefully removed as soon as they grow so that the engrafted branch may receive nourishment without any hindrance. The engrafted pistachio tree begins to bear fruit generally in its sixth year while the ungrafted tree in its 7th or 8th year. The quantity of the fruit increases with the age of the tree. In Persia, the pistachio is grafted on the stock of a tree called *banesh* (*shane* in Pushto) which bears fruit like small green grains and this practice has proved very profitable. The *shane* trees are abundantly found in the hills of Baluchistan and in some hilly tracts of North-West Frontier Province. For grafting purposes all the branches of the *shane* tree are clipped first at the end of winter so that it may tiller. The following year the pistachio is grafted on to these new shoots. In this way a big *shane* tree is transformed into a pistachio tree which produces this valuable fruit, although *shane* itself does not yield good fruit nor can its wood be used for purposes other than as fuel.

Average yield

The average production of pistachio nut varies according to the age of the tree. A seven-year old tree yields about 1 lb. of pistachio nut annually, a ten-year old tree about 2 lbs., a fifteen-year old tree about 12 lbs. and a twenty-five-year old about 20 lbs. of nuts. [R. L. S.]

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AFRICAN *BAJRI* (*PENNISETUM* SP.)

African *bajri* has been tried at various places in India. The Bombay Department of Agriculture has carried out some comparative trials with the local *bajris* in different districts. The results of these trials are summarised below :—

The yield of the African *bajri* in many places has not been greater than the local or the Akola type. The straw yield has been higher in a few places but the straw was rather coarse. African *bajri* seems on the whole to do well under irrigated conditions as the results of trials in the Deccan Canals area show, but it has

got a number of defects such as rather coarse and somewhat hairy fodder, small and uneven grain, late ripening, lodging, and susceptibility to bird attacks. The *bajri* is very showy on account of its exceedingly long head. African *bajri* as now generally grown is a great mixture of types. There is a considerable danger of its crossing naturally with the local *bajri* varieties and producing a mixed population which may be less useful than the existing types.

Trials were also carried out on this *bajri* in Sind and the reports of the department there indicate that it did not show any great improvement over the local varieties specially with regard to fodder, in which connection it was found inferior. It was considered useful for small, localised irrigated tracts of the desert area of the Thar Parkar District where its higher yield was likely to be appreciated by the cultivators who have no particular preference in grain characters or taste. It was definitely inferior for dry tracts in comparison with the local types.

The following are some details kindly supplied by the Bombay Department of Agriculture dealing with trials made in 1935-36 and 1936-37 :—

(1) *Nadiad Farm.*—The crop was not an economic success as the yield of the African *bajri* was poor in comparison with the local varieties. Fodder was very coarse and was not much relished by the cattle. Chemical analysis of grain and fodder also showed that they were of poor feeding value in comparison with the local varieties.

(2) *Ahmedabad District.*—Experiments in this district in both years, *i.e.* 1935-36 and 1936-37, showed African *bajri* to be superior in yield to the local *bajri*, but the fodder was inferior to the local type on account of its stalks being woody and hard.

In the Panch Mahals Division, African *bajri* was appreciated for its grain yield and was less attacked by the hairy caterpillar during early stages than maize. It was damaged by birds during the grain formation period.

(3) *Nasik District.*—African *bajri* proved superior in yield to local and Akola *bajri*, but its fodder was coarse and grain had no lustre. It was inferior in taste as compared to the local type.

(4) *South Central Division.*—The African *bajri* gave better yield of both grain and fodder in 1935-36 as compared to the local Akola *bajri*. Its fodder was relished by the cattle as it was more leafy but the analysis of the straw of both the varieties did not show much difference. Similar results were obtained in 1936-37. The variety was late and ripened one month later than the local type. It was very badly attacked by borers. It proved useful for the irrigated tracts where its high yield compensated for other defects. Its grain was inferior as compared to the local and the Akola *bajri*.

(5) *Niphad.*—In 1935-36 the African *bajri* was compared with the Niphad local and was found inferior to the local both in grain yield and fodder but was superior in chaff. The grain of the African was very small and poor in quality.

In 1936-37 it proved inferior to the local in all the three important characters, *i.e.* yield, straw (in quality) and size of grain and weight. In addition to these drawbacks it also had two more defects, *i.e.* (i) longer ripening period—about 15 days—and (ii) poor colour of grain. Cattle did not relish the straw of this *bajri* as it was too coarse. The crop was also attacked by birds. Local *bajri* is harvested long before the African. The colour of the grain is definitely unattractive and does not, therefore, fetch the same price as the local. It does very well under irrigation but it is liable to lodge badly as the ear-heads are top-heavy. Results of the trial at Niphad are as follows :—

	African *bajri*	Niphad local
Grain per acre	633 lbs.	858 lbs.
Fodder	1,252 „	1,904 „
Chaff	337 „	215 „
Number of grains per gram	245 „	156 „
Weight (¼ *paili*)	75 oz.	91 oz.

The differences were significant.

(6) *Poona trials* (by the Economic Botanist). Two trials were conducted at different dates (*i.e.* 22nd July 1935 and 29th August 1935) on a replicated basis. The first showed significantly superior results of Akola *bajri* both in the production of grain and fodder over the African while the second trial showed the reverse results. Thus, with a July sowing, the African type was inferior to the Akola type but with late sowing during August the African proved superior. The African *bajri* was found consistently and significantly late by about three weeks as compared to the Akola type. The results indicated that the superiority, if any, of the African *bajri* over the local was of a highly doubtful nature.

(7) *Deccan Canals* area trials showed better grain yield of the African type.

	Grain per acre lbs.	
	African *bajri*	Akola *bajri*
Pravara Canals	1,060	940
Nira Left Bank Canal	1,800	1,200
Nira Right Bank Canal	2,912	896
Godavari Canal	569	792

The crop on the Pravara Canals was not irrigated and in other trials it was irrigated. The low yield in the Godavari Canal was due to the serious attack by birds. The fodder of African *bajri* was also relished by cattle but the analysis of straw of the African and Akola *bajri* did not show much difference.

(8) In the *Gujarat districts* it is doubtful if the farmers will ever take up the cultivation of the African *bajri* as its fodder is coarse. Under the Gujarat conditions there was no large variation in the grain size of African *bajri*. The results of a trial are as follows :—

	Yield in lbs. per acre.	
	African	Selection No. 207
Grain and straw	1,670	2,850
Straw (lbs.)	9,280	5,957

The results of two places in the district are as follows :—

	Grains per acre in lbs.		
	Local	Akola	African
Nasik	373	428	480
Sinnar	360	380	704

The grain of African *bajri* has no lustre and is small and the fodder is coarse and not useful [R. L. S.]

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LEGISLATIVE MEASURES ADOPTED FOR THE ERADICATION OF NOXIOUS WEEDS IN DIFFERENT PROVINCES IN INDIA

In most of the provinces in India no legislation against noxious weeds has been passed. Such legislation as exists has been directed almost entirely against water-hyacinth (*Eichhornia crassipes* Solms).

1. *Bengal.*—The province which has suffered most from this weed is Bengal. In this Province the eradication of water-hyacinth has been made compulsory by legislation within notified areas. The occupier of the land has been made responsible for clearing up any water-hyacinth on the land and failure to do so has been made a penal offence. In the localities that have been notified as places within which no occupier of land shall allow water-hyacinth to exist on his land, there exist non-official organisations formed mostly under official supervision for clearing up the pest by free labour. In a number of districts these organisations have been very successful and in fact it is the success achieved by these organizations which led to the passing of the Bengal Water Hyacinth Act (Act XIII of 1936) in order to deal with persons who refuse to co-operate with the local organizations for the eradication of water-hyacinth. Uptill now only places where such organizations already exist and have achieved a reasonable amount of success have been notified under the Act, so that the work is being mainly carried on by voluntary organization of free labour and coercive action is taken very sparingly and only in case of those who deliberately refuse to co-operate with the local organizations. As the owners

of private property have formed themselves into organizations for the eradication of the pest no difficulty is experienced with regard to such property. Some difficulty is felt regarding land in the personal possession of the landlord or land in the possession of large business concerns like Railways. The policy with regard to such land is that the local organization concerned should clear up the water-hyacinth of such land, the landlord or the company being regarded as having discharged their obligations under the act if they render reasonable assistance and facilities to the local organization. The Act came into force on 1st August 1936 and it is yet too early to say what the ultimate result achieved will be; but the legislation as it stands is at present considered effective.

2. In *Assam*, there are provisions in the Assam Municipal and Local Self-Government Acts enabling the local bodies to require landholders to eradicate the weeds *Lantana*, *Ageratum* (*Eupatorium*) and water-hyacinth or to effect this at the cost of the landholder. The Water Hyacinth Act makes the cultivation or transport of water-hyacinth (or any noxious weed which may be declared so by the Local Government) punishable with a fine. It also enables the local body to require occupants or owners to assist in destroying the weed, and to frame schemes for such destruction by co-operation of persons interested, with compulsion upon all concerned to assist. It may be made the responsibility of the occupier, but the Water Hyacinth Act recognises that the work of destruction may in some cases be a matter for co-operation between persons of diverse interests, and that it is the business of the local body to promote and assist such enterprise. Little or no action has been taken by the local bodies in the exercise of these powers. Last year, however, considerable success has been achieved by the co-operation of the district officers, official staffs and villagers in the eradication of water-hyacinth by hand. There is no cut-and-dried organization for this purpose, but appeals were issued and public meetings were held to devise plans of campaign. The Assam Local Self-Government Act was passed in 1935, the Municipal Act in 1923 and the Water Hyacinth Act in 1926. Legislation in itself has not been effective.

3. In *Madras* the water-hyacinth is considered a noxious weed under the provisions of the Madras Agricultural Pests and Diseases Act, 1919 (Madras Act III of 1919). The Act was put in operation against the weed for the first time in 1920. The eradication of this weed is the duty of the owner or occupier of the land, channel or pond. Revenue Inspectors, Minor Irrigation Overseers and Supervisors of the Public Works Department are appointed as Inspecting Officers under the Act. These officers draw the attention of the owner or occupier to the existence of this weed wherever found and ask him to remove it. If he does not eradicate the weed, the officers of the Revenue Department have it removed after issuing notice to the owner or occupier and recover the cost of removal from him. The Inspecting Officers take action under the Act in the course of their other duties. If the weed is found on public lands, tanks or channels, it is removed by the Department concerned. Officers of the Agricultural Department bring to the notice of

the Inspecting Officers the existence of this weed wherever found in the course of their duties. No separate organization exists for this purpose. The steps so far taken are considered effective as this weed is not found in vast areas.

4. In *Bihar* water-hyacinth is the only noxious weed of any importance and is found only on a limited scale. No legislative measures have been adopted to eradicate this weed.

5. In the *United Provinces*, no plants have been proclaimed as noxious weeds by the United Provinces Government. The only noxious weeds concerning which any action has been taken by Government are water-hyacinth and *kans* grass (*Saccharum spontaneum* L.). Government has rendered some assistance in the reduction of these by small grants for the removal of water-hyacinth for compost-making and in deep ploughing for *kans* grass with tractors in Bundelkhand. This is being done at concession rates for the landholders of heavily-infested areas.

6. In the *Central Provinces*, an Agricultural Pests and Diseases Act, No. XXXV, 1936, has recently been enacted for the prevention of the spread of insect pests, plant diseases and noxious weeds, but no notification has been issued under it. Under section 4 of the Act referred to above, it will be the duty of every occupier within a notified area to carry out the prevention or remedial measures. As the Act has not been brought into operation yet, the question of the steps to be taken to enforce this responsibility has not arisen. The Act does not impose any duty on any local body. The only duties imposed on non-officials are on village officers under section 8 of the Act.

7. There is, however, no legislation against noxious weeds in *Bombay*, *Punjab* and *Sind*.

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STATISTICS OF THE PRODUCTION OF CERTAIN SELECTED INDUSTRIES IN INDIA

THE following statistics are reproduced from the "Monthly Statistics of the Production of certain selected Industries of India, for January, February, March and April, 1937."

Detailed statement of the quantity and description of jute manufactures produced in India

Description		Month of January		Month of February		Month of March		Month of April	
		1936	1937	1936	1937	1936	1937	1936	1937
I. Twist and yarn .	tons	3,383	4,568	3,217	3,991	3,368	3,927	3,966	3,499
II. Manufactures—									
Canvas . .	tons	100	177	101	64	145	329	233	348
	yds.	198,087	362,176	174,510	109,339	259,461	646,292	475,608	671,820
Gunny bags—									
(a) Hessian .	tons	4,570	4,500	5,288	3,804	6,235	4,764	7,446	4,136
	No.	10,192,663	11,559,586	13,102,349	9,637,721	15,934,782	12,668,939	16,354,122	9,963,163
(b) Sacking .	tons	46,213	55,232	42,899	49,800	44,402	50,877	50,997	43,200
	No.	46,428,842	55,451,427	42,735,027	49,464,547	43,193,174	50,409,508	47,987,777	41,610,080
Gunny cloth—									
(a) Hessian .	tons	29,195	40,993	26,565	36,313	27,492	34,528	31,376	29,636
	yds.	112,687,968	158,691,698	103,153,591	139,682,760	106,358,864	132,219,303	123,568,607	113,244,032
(b) Sacking .	tons	2,182	2,832	1,987	2,463	1,922	2,673	1,899	2,233
	yds.	4,925,983	6,217,994	4,558,963	5,592,521	4,254,889	6,060,144	4,219,236	5,303,293
Other manufactures including rope and twine.	tons	274	798	293	847	331	705	401	540
Total .	tons	*85,917	109,100	80,350*	97,282	83,895*	97,803	96,318*	83,592
	yds.	*117,812,038	165,271,868	107,887,064*	145,384,620	110,873,214*	138,925,739	128,263,451*	119,219,145
	No.	*56,621,505	67,011,013	55,837,376*	59,102,268	59,127,956*	63,078,447	64,341,899*	51,573,193

* Revised.

Detailed statement of the quantity and description of sulphuric acid produced in India

Description	Month of January		Month of February		Month of March	
	1936	1937	1936	1937	1936	1937
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Ordinary or non fuming sulphuric acid	42,530	46,619	38,277	47,352	52,504	58,568
Fuming sulphuric acid	25	...	...	22	...	...
Total	42,555	46,619	38,277	47,374	52,504	58,568

Detailed statement of the quantity and description of sulphate of ammonia produced in India

Description	Month of January		Month of February		Month of March	
	1936	1937	1936	1937	1936	1937
	Tons	Tons	Tons	Tons	Tons	Tons
Neutral	1,521	1,332	1,350	1,316	1,436	1,664
Acid	20	42	18	32	17	55

Detailed statement of the quantity and description of sugar produced in India

Description	Month of January		Month of February		Month of March		Month of April	
	1936	1937	1936	1937	1936	1937	1936	1937
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
(*i*) *Khandsari* sugar*	(*a*) 11,851	6,455	(*a*) 15,545	11,586	15,939	12,532	(*a*) 11,020	6,903
(*ii*) All other sugar except Palmyra sugar.	(*a*) 3,858,841	4,482,091	(*a*) 3,944,224	4,291,001	3,808,260	4,435,716	(*a*) †2,201,593	†3,563,650
(*iii*) Palmyra sugar	19,063	18,571	23,943	20,969	16,772	9,046	(*a*) 6,669	8,833
Total	(*a*) 3,889,755	4,507,117	(*a*) 3,983,712	4,323,556	3,840,971	4,457,294	(*a*) 2,219,282	3,579,386

* Figures relate to excised issues only. (*a*) Revised. † Excludes production in Burma.

Detailed statement of the quantity and description of wheat flour milled in India.

[In bazaar maunds of 82 2/15 lbs. each.]

Description	Month of January		Month of February		Month of March		Month of April	
	1936	1937	1936	1937	1936	1937	1936	1937
	Mds.	Mds.	Mds	Mds.	Mds.	Mds.	Mds.	Mds.
Flour	454,146	532,456	394,849	418,180	424,614	429,973	424,445	530,344
Atta—								
High grade . . .	274,203	342,772	249,546	229,209	243,424	285,584	303,484	277,703
Low grade . . .	158,224	160,192	149,611	196,997	107,847	182,760	162,271	199,523
Bran	208,141	211,355	186,346	174,334	189,922	184,141	210,868	222,178
Soojee	38,703	47,311	32,394	30,819	22,894	39,525	40,151	45,218
Others	7,462	6,902	6,512	7,185	7,359	5,512	6,732	8,009
Total	1,140,879*	1,300,988	1,019,258*	1,056,724	996,060	1,127,495	1,147,951*	1,282,975

* Revised.

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NEW METHODS OF SOIL CULTIVATION

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

Considerable progress had been made in recent years in regard to the determination of the best period for ploughing the soil and also for the proper speed and depth of ploughing, factors which are highly important in the improvement and rationalization of methods of cultivation.

The International Institute of Agriculture at Rome has recently published in the "International Review of Agriculture" a study describing the results obtained in respect of ploughing technique.

The article lays special stress on the form and type of the ploughs employed, a matter of fundamental importance in the proper ploughing of the soil. Ploughs vary greatly in form and in type as between one country and another and also as between one district and another. Some very important improvements have recently been made in this respect and the substitution of the plough by other implements and through the use of new ploughing methods is under consideration.

Among the implements whereby in many cases it is possible to replace the plough and other implements used for the supplementary preparation of the soil, may be mentioned rotary tillers, pulverator ploughs, sub-soil ploughs and cultivators with rigid prongs.

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THE INFORMATION SERVICE OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE ON THE SITUATION OF CROPS

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

At this season of the year, when the interest of agricultural quarters is concentrated on the harvests now in course, the I. I. A. devotes its attention mainly to the collection, frequently by cable, of official information, forecasts and estimates of crop production from all parts of the world. After examination and comparison, this information is published as promptly as possible by means of press or wireless communiqués. Wireless communiqués are issued weekly in five languages (French, English, German, Italian and Spanish) from the Italian Stations Rome I (420·8 m.) and Rome 2 R O (25·4 m.).

In addition to making its contribution to the technical and scientific study of the problems of world agriculture, the Institute thus attempts also to bring practical, exact and objective information within the reach of everyone interested

in the progress of agriculture. In the last two weeks, for example, it has transmitted the latest information on the cereal crops of North America and North Africa, two important sources of the world's wheat supplies.

The Institute reported that on 10 July the crop situation was good in the United States and that this country, which was an importer in the last two commercial years, will again be able to export wheat. In Canada, on the other hand, the crop outlook is very poor and, according to a report of 15 July, further deterioration is likely. Canada will consequently hand much smaller supplies, as its end-of-season stocks are also rather low. It is thus very probable that Canadian supplies for export will be comparatively light.

North Africa, which has a wheat crop of about average size but a mediocre barley out-turn, does not appear to be in a position to export appreciable quantities.

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THE WORLD COFFEE SITUATION

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

The estimates at present available for the production of coffee in 1936-37 supplied to the International Institute of Agriculture by the Government and various special organizations in the producing countries refer to over 90 per cent of world production and thus enables the volume of the world crop in the current season to be established with sufficient accuracy.

Though about 529 million pounds larger than the figures of last season, the estimate of the world crop for 1936-37 remains appreciably smaller than the crop of the three preceding seasons. However, on the whole, the coffee season 1936-37 may be placed amongst those which, attaining neither a maximum nor a minimum as so often determined by the great fluctuations characteristic of the crop, ensure a good average production.

The geographical distribution of the coffee crops shows fully on the one hand the tendency to extension of the coffee crop in recent years which is characteristic of the coffee crop in the countries of Central America and still more in those of Africa and, on the other hand, the fairly stable character of the Asiatic crops, especially those of the Netherlands Indies and of India.

The first place as a great coffee producer remains, however, with South America, which supplies about four-fifths of the world production, with Brazil at the head, followed at a long distance by Columbia and Venezuela. In the

1936-37 season the total volume of crops in the producing countries of South America has on the whole showed an appreciable reduction with respect to the crops of the three preceding seasons, despite the very abundant production of Columbia and a record crop in Venezuela ; the reduction is, in fact, attributable exclusively to Brazil, where crops of the last two seasons remained very much below normal. The determining factor in the diminution of the Brazilian crops must be sought in the policy of protecting the coffee market that the Brazilian Government has pursued for some years and which is reflected in the abandonment of the area occupied by the less productive plantations.

The world economic depression, characterized for a number of years by increasing restrictions of exchange and, in several countries, by a policy of quotas, has appreciably influenced the import trade in coffee and led to a severe contraction of world demand, while at the same time checking the tendency to increase that was observed in the years following the World War. The volume of world net imports, which was 2,336 million pounds in 1909-13, rose to 3,064 million pounds on the average from 1926 to 1930 and reached its maximum in 1931 with 3,594 million pounds. Subsequently and especially in the following three years world demand very markedly declined but still absorbed on the average a quantity of coffee 132 million pounds, larger than the average for 1926-30.

In 1935 and 1936 an appreciable recovery was experienced in the world trade in coffee and net imports attained very high figures, only inferior to the record of 1931. It should, however, be noted that, even with the tendency to increase, the import trade in coffee showed different characteristics in the principal world importing centres, especially as regards the United States and Europe, which together absorbed more than 90 per cent of the world imports. In the United States the tendency to increase and the corresponding change in the figures was more marked than in Europe ; imports in the last two years were double the pre-War average, while the maximum attained in 1931 in European countries as a whole exceeded only by a quarter the average quantity imported in the quinquennial period prior to the War. However in the latter continent, as in the United States, net imports in the last two years show a fairly appreciable increase with respect to the three preceding years and to the 1926-30 average.

The policy of regular destruction of coffee decreed in 1931 by the Congress of the producing States in Brazil " in order to obtain as soon as possible a betterment in the statistical position of coffee, the selection of commercial qualities and the elimination of all useless expense in storage " continued without interruption : the total quantity of coffee eliminated in Brazil from 1931 to the end of December 1936 was 5,259 million pounds, a quantity exceeding by more than fifty per cent the average annual imports of the last six years.

In consequence of this radical measure, the statistical position of coffee, though improved, remains rather heavy, especially if account is taken of the good prospects of coming crops in Brazil and other large producing countries. It may thus be expected that the various organizations for the control of coffee will continue during the coming season to regulate and support their respective internal market. The greatest obstacles that hinder the policy of regulating the internal market, as pursued by the producing countries, consist, however, in the present restrictions on international exchange of goods and money and particularly in the customs duties, that are imposed on coffee imports into the majority of consuming countries, especially in Europe, where the limitation of coffee consumption is accompanied by the increasing use of substitutes.

ABSTRACTS

Observations on phyllody of sesamum in Burma. D. Rhind, F. D. Odell and U Thet Su. (*Ind. J. Agric. Sci.* **7**, 823)

In Burma nearly every crop of *Sesamum orientale* Linn. is partly affected by phyllody. Observations made since 1923 at different stations in Burma have shown that so far as the monsoon (long day) crop is concerned selection has greatly reduced the incidence of the disease. Great seasonal fluctuations are noted as well as varietal differences in susceptibility. Early sowing has been shown to enhance the ount of the disease in the resulting crop. Inoculations by various methods have given no decisive results. The higher mineral metabolism of affected plants is recorded. The authors advance the theory that the condition can be accounted for by the known high susceptibility of sesamum to small changes in environment and the fact that no cultures can be considered homozygous for more than a few main agriculturally important factors. Changes in conditions acting on a variety of physiological characters are thought to be the most probable cause. (*Authors' abstract*)

Studies in Indian oil-seeds, VI. Some correlations between oil-content and other characters in the Pusa linseed hybrids. R. B. Deshpande and A. K. Mallik. (*Ind. J. Agric. Sci.* **7**, 841)

The paper deals with correlation studies between oil-content and some other characters in the Pusa linseed hybrids. The oil-content in these hybrids is found to be negatively correlated with the seed colour intensity. The dark-seeded hybrids, *viz.* brown and gray, have a lower oil-content than the lighter-seeded hybrids, *viz.* fawn and yellow. The factor **G**, which converts yellow seeds to gray and fawn to brown, appears to lower oil-content.

Seed-size is positively correlated with the seed-colour intensity. The yellow-seeded hybrids are the smallest in weight and the brown-seeded the boldest. The gray and fawn-seeded hybrids are intermediate. The seed colour factors, **D** and **G**, also appear to influence seed-size.

Oil-content and seed-size do not appear to bear any relationship in these hybrids. (*Authors' abstract*)

Breeding investigations in some of the oleiferous *Brassicae* of the Punjab. Ali Mohammad and Sawan Mal Sikka. (*Ind. J. Agric. Sci.* **7**, 849)

The authors have recorded results of studies into the inheritance of some characters in crosses between a few self-sterile and self-fertile forms of oleiferous *Brassicae*,

viz. toria (*Brassica napus L.* var. *dichotoma* Prain) and *sarson* (*Brassica campestris* L. var. *sarson* Prain).

The difference between hairy and smooth leaves, and between extrorse and introrse anthers has been proved to be monogenic. The inheritance of seed colour and self-fertility has been shown to be somewhat complicated, due mainly to the impurity of the self-sterile parents with regard to these characters. From the data recorded on the inheritance of these characters it has been shown, that seed colour, of which six different phenotypes have been identified, is controlled by more than one factor, and self-fertility by a single factor. Data have also been presented to show, that self-fertility is inherited independently of seed colour and position of suture of anthers.

As a result of these studies, the authors have evolved a large number of new self-fertile hybrids having combinations of desirable characters. (*Authors' abstract*)

Colours in the rice grain. K. RAMIAH and C. RAJASEKHARA MUDALIAR (*Ind. J. Agric. Sci.* **7**, 863)

HISTOLOGICAL studies of the commonly occurring rice colours, namely, red, light red, grey brown, gold and purple were studied. Spermoderm (seed-coat) in one way or the other is the seat of colouration occurring in the rice grain. The maximum development of the spermoderm is attained in the red rices, any time from the seventh day after fertilisation up to the time of maturity. Spermoderm is poorly developed in light red rices. In grey brown rices the pigment appears very late in the development of the grain, and the thickening of the spermoderm is also not so uniform as in red rices. In gold rices the pigment could be seen even on the seventh day in the cutinised inner wall of the spermoderm and as the grain ripens, the colour spreads to the spermoderm. Only occasional cells of the spermoderm are thickened as in grey brown rices. Purple colour is distinct from the other rice colours since it occurs in the whole of the pericarp. Though the seed-coat takes part in the early stages of development, it is completely disorganised when the pigment occupies the whole of the pericarp. Among the colours, purple alone is affected by water, acids and alcohols. (*Authors' abstract*)

Effect of farmyard manure on the fibre-characters of cotton. H. R. NAYAK (*Ind. J. Agric. Sci.* **7**, 877)

JAYWANT cotton grown on the Dharwar Farm during the three seasons, 1931-32, 1933-34, and 1934-35, under varying rates of farmyard manure was studied for several fibre-characters and ginning out-turn and the following conclusions were arrived at.

The application of varying rates of farmyard manure show that the optimum conditions for the quality of cotton were obtained with five tons of farmyard manure to *jowar* which was the previous crop, while lighter and heavier doses brought about a decline in quality in one respect or the other.

The mean values of the two sets of samples of 1934-35 and the means for all the seasons show that the application of five tons farmyard manure to *jowar* yielded longer staple length, increase in fibre-length irregularity and an increase in the number of mature hairs.

The mean fibre-weight values decreased with the increasing rate of farmyard manure, the difference between two successive values being also significant.

The values of the mean fibre-strength showed a decreasing tendency with the increasing amount of farmyard manure.

The ginning percentage showed a decreasing trend with the increasing rate of farmyard manure application. (*Author's abstract*)

A note on two new genes affecting anthocyanin pigmentation in Asiatic cottons. J. B. HUTCHINSON and R. L. M. GHOSE. (*Ind. J. Agric. Sci.* **7**, 873)

A NEW member, red spotless, R_2O, of the anthocyanin multiple allelomorph series, is described, and its position in the series established. Red spotless differs from red leaf, R_2L, in the absence of petal spot. It is pointed out that the discovery of this gene necessitates reconsideration of Hutchinson's speculation on the organisation of the anthocyanin genes, and leads to the expectation that genes may be discovered giving further combinations of anthocyanin distribution.

The existence is demonstrated of a petal spot reducer, **Sr**, in a strain of *G. arboreum* var. *neglectum* from Nagpur. A second factor probably operates to intensify the effect of **Sr**, but it has not yet been possible to analyse its mode of action completely. (*Authors' abstract*)

The influence of non-nitrifying organisms on nitrification. S. V. DESAI and FAZAL-UD-DIN. (*Ind. J. Agric. Sci.* **7**, 895)

ALL soluble organic matter is toxic to a pure culture of nitrifying organisms. These organisms are able to withstand the toxic effects of soluble organic compounds in the presence of other saprophytic organisms. This phenomenon is explained on the basis of a symbiotic relationship existing between nitrifying organisms and non-nitrifying flora. This relationship also benefits the non-nitrifiers as is seen by their increase in number when nitrifiers are present. Different non-nitrifiers differ in their power of destroying toxicity and stimulating nitrification. Mixtures of different organisms have greater power than any single organism in this respect and this property is neither a function of their ammonifying power nor of their growth in the medium. Nitrification increases with the increase in number of organisms introduced in the inoculum.

Protozoa have no effect on the process of nitrification. (*Authors' abstract*)

The Black Beetle (*Alissonotum impressicolle* Arr.): A pest of sugarcane in Myitkyina district in Northern Burma. C. C. GHOSH (*Ind. J. Agric. Sci.* **7**, 907)

THE author describes in detail the life-history of the principal pest, *viz.* the Dynastid Beetle, *Alissonotum impressicolle* Arr., and its activities causing damage. The beetle is active from March to July and again in October-November when eggs are laid. Grubs are active from December to February. The natural enemies observed among birds were crows, Mynahs (*Acridotheres tristis*), Pied Harriers (*Circus melanoleucus*) and Wagtails (*Motacilia alaba*), among insects an Asilid Fly (*Philodecus femoralis*), a Scoliid Wasp (*Elis annulata*), an unidentified Tachinid Fly and Carabid Beetles (*Scarites* sp.) and grubs and among fungi, *Meterrhizium anisopliae* and *Cordyceps* sp. The combined effect of the work of the natural enemies was hardly appreciable as a check on the pest.

Control measures which were tried included use of baits, traps, baited and unbaited, insecticides, hand collection, submergence under water and cultural methods. Deep traps made of empty kerosine tins and baited with molasses, acetic ether, lactic acid, formic acid, amyl alcohol and Japanese Beetle bait containing molasses, glycerine, gereniol and eugenol were not effective. Split canes used as baits failed to attract sufficient numbers. Insecticides tried included cynao-gas (calcium cyanide), a dust, carbon bisulphide, potassium cyanide, para-dichlorobenzene, carbon bisulphide and para-dichlorobenzene and three proprietary soil fumigants, *viz.* Seckay, Little's Soil Fumigant and R. V. 4. None was really effective under field conditions. Submergence forced out the beetles which were otherwise unaffected and would control grubs if of long duration but would hardly be practicable. Hand collection could not get at all beetles and grubs. The only methods found effective were restriction of ratooning and fallowing at least for a year.

Other Dynastid Beetles which occurred in the company of the above were *Alissonotum crassum*, *Heteronychus liodcres*, *H. sublaevis* and *H. robustus* but none of them in really injurious numbers. (*Author's abstract*)

Studies on the mineral requirements of cattle in North-East India (with special reference to rice straw feeding). M. CARBERY; INDUBHUSAN CHATTERJEE and SUBODH KUMAR TALAPATRA. (*Ind. J. Vet. Sci. & Anim. Husb.* **7**, 155).

AN intensive study of the mineral requirement of cattle under Bengal conditions (which may be said to be the typical of North-East India) has been attempted on the basis of feeds in which rice straw formed the main roughage. The investigation represented condition in which some of the important minerals have gone up from the stage of deficiency to that of adequacy, thus suggesting the lowest limit compatible with positive retention.

There were six broad combinations embracing thirty individual tests. In five of these rice straw (*Aman* or winter variety and *Aus* or autumn variety) formed the main roughage, and linseed cake or rice *kura* (bran) formed the concentrates, except

where straw was given as an exclusive feed. The sixth combination consisted of green feeds plus rice straw divided into three sub-groups of hyacinth, Napier grass and Guinea grass.

All computations were based on 500 lb. live-weight (the approximate live-weights of the animals on this side of India). On this basis the minimum mineral requirements (when rice straw forms the main roughage) appear to be 24 grams calcium oxide, to grams phosphoric acid, 15 grams magnesium oxide, 70 grams potassium oxide, 17 grams sodium oxide equivalent to 32·05 grams sodium chloride, and 20 grams chlorine equivalent to 32·97 grams sodium chloride. On doubling the amount, the requirement on the basis of 1000 lb. live-weight can be obtained.

The lime requirement under rice straw feeding appears to be higher than with many other feeds. It is suspected that this might be associated with high potash ingestion through its presence in large quantity in rice straw or the presence of some anti-calcifying agents or a combination of both. These have been thoroughly discussed in the text.

In spite of a large ingestion of potassium oxide from rice straw, positive balance was not obtained until the ingestion was about 66 to 70 grams potassium oxide per 500 lb. live-weight. A heavier potash ingestion (96 grams to 173 grams per 500 lb.) as was supplied through hyacinth and Napier grass induced an excretion greater than the intake. On the other hand a higher ingestion of calcium oxide seems probably to affect the potash balance as is suggested from the behaviour of Guinea grass group.

Rice *kura* or bran is very poor in lime (0·2 per cent) and rather unusually rich in phosphoric acid (over 6 per cent). In this combination calcium oxide and chlorine figures have definitely given negative balance, while in spite of heavy phosphoric acid ingestion (39 grams to 59 grams phosphoric acid) positive balance could not be attained until the ingestion was about 43 grams. This is probably due to the presence of phytin in rice bran. There might also be other anti-calcifying agents.

The results indicate that *Aus* straw is considerably superior to *Aman* straw in minerals and protein and hence in general feeding values, but both straws are poor in phosphate and slightly deficient in lime. The phosphate might be conveniently supplied through cake while a small supplement of chalk would make up lime deficiency.

In the case of green feeds Guinea grass is better balanced than Napier but the feeding should better be regulated in order to avoid a large ingestion of lime through its heavy feeding. Napier should always be supplemented with calcium carbonate. Hyacinth can hardly be classed as a feed, but the scarcity of fodder often compels its use in some parts of Bengal. It contains a large quantity of potassium chloride and its feeding should always be on a controlled basis.

In rice straw phosphorus is probably the chief limiting factor although at the same time there is some lime deficiency mainly due to defective assimilation possibly associated with a large potash ingestion. (*Authors'a bstract.*)

REVIEWS

Forests in Relation to Climate, Water Conservation and Erosion. (Extracts from the proceedings of the British Empire Forestry Conference, South Africa, 1935. Government of India Press, New Delhi, 1937.)

THE Committee was appointed at the special request of the Minister for Agriculture and Forestry, Union of South Africa and was directed to enquire into the whole question of forest influence, *i.e.*, the effect of forests on climate, water conservation and erosion with special reference to South Africa and the establishment in that country of forests of exotic species. It was held under the chairmanship of Sir C. Gerald Trevor, Inspector-General of Forests in India, and consisted of the following members :—

J. R. Ainslie, Chief Conservator of Forests, Nigeria.

W. F. Baldock, Offg. Conservator of Forests, Kenya.

N. V. Brasnett, Forest Officer, Tanganyika.

E. H. Finlayson, Director of Forestry, Canada.

A. V. Galbraith, Chairman, Forestry Commission, Victoria.

J. D. Keet, Director of Forestry, South Africa.

A. O'Connor, Conservator of Forests, South Africa.

R. S. Troup, Professor of Forestry, Oxford.

R. W. Thornton, Colonial Civil Service.

Besides the above-mentioned members of the Committee, certain other officials attended the conference who for many years have had the subject under constant review and who, therefore, were competent to treat the matter with some degree of authority. The report of the Committee has given an account of the effect of forests on various factors, such as temperature, rainfall, wind and humidity which sums up climate and their benefits. There can be no question that forests have an ameliorating effect on climate and that they have tended if anything to increase the humidity of a climate. Apart from their utility in the supplying of wood products, some of the most beneficial effects of forests lie in their influence in conserving the supply of water for natural springs and reservoirs and in regulating the flow of streams and rivers. Precarious water supply has been increased by the afforestation of the catchment area of the streams and experiments in different countries have proved that a more equable flow of water is obtained from afforested area than from a disafforested area. The Committee recommended that all

important catchment areas throughout the Empire should be placed under some forest management. One of the greatest calamities which have been brought by the destruction of the forest is the erosion of the land surface. This has already destroyed the fertility of many lands and is at the present day exercising a powerful influence on the destinies of peoples. Erosion results from the misuse of the surface covering of the earth, whether it be by the destruction of forests which covered it, by the misuse of arable or pasture land, by bad methods of cultivation, by burning, or by over-grazing. Erosion is worse in countries of low rainfall and hot summers than where ample rainfall covers immediately any bare surface with vegetation. The nature of the geological formation exercises a powerful influence upon the rapidity of erosion. There is evidence, however, from all over the world that even where erosion, especially sheet erosion, has actually commenced it is possible to remedy the position by preserving the natural vegetation and by afforestation. Where extensive gullying is already present, afforestation must be combined with engineering operations of a minor nature such as construction of small dams, fascines, etc. The combination of such engineering operations with the protection of the soil from burning and grazing together with afforestation can deal with the problem. The Committee further recorded that grass burning also requires careful and judicious handling. All the existing evidence, however, points to the fact that it should only be done when absolutely necessary and that it should not take place when weather conditions are such that the blackened surface of the ground will be left for months uncovered at the mercy of the desiccating powers of the sun and wind. Where grass land is the climax type, excessive burning can do nothing but harm and will result in a deteriorated and weedy pasture, hastening the onset of erosion. Each type of veld depending on climate, altitude, soil and type of vegetation, must, therefore, be dealt with on its merits and the degree of burning necessary to remove the surplus dry vegetable matter determined.

In the course of the debate various members who attended the Conference related their experience. Sir Gerald Trevor gave instances from history of the results of the destruction of forests on the civilisation of man and the fertility of the land in India. Mr. Galbraith dealt with the improvement of the Murray River catchment area which is the source of very important irrigation scheme on which the prosperity of three states in Australia will depend. Mr. Keet dealt with the desiccation of the country from the standpoint of South Africa. He stated that rivers which at one time had hippo-pools in them no longer possessed these pools. Mr. Ainslie dealt with the very serious wind and water erosion in Nigeria—its effect on the savannah forest there and the degradation of the soil which has resulted from the various destructive habits of the people such as overgrazing and cutting so that countries which were at one time prosperous followed a different policy and a certain amount of civilisation had deteriorated and the land had practically become a desert. He further stated that erosion was worse in areas of low rainfall where the roots die on the surface, all the soil is blown away

and that he preferred natural forests in such areas where water supply was of paramount importance. Mr. Hunt Holley (Union of South Africa) gave his opinion founded upon great experience that the proper management of the wattle industry had had no bad effect on the soil: that erosion on his land was non-existent and that the planting of that large area of wattles had had no ill effect on the water supply on his farm. He, moreover, pointed out that on his neighbour's land which was largely unplanted very serious effects of floods had been experienced over a series of years. Mr. Finlayson dealt with the sand-dunes formation along the banks of the St. Lawrence River. In the early days farms were cut out of the forest and these were succeeded by the formation of sand-dunes and now mankind has to repair the damage at considerable expense. He also dealt with the decrease in stream flow of the St. Lawrence River—one of the chief water-ways of the world. He also drew attention to the fact that afforestation on the Elbow River had had a beneficial effect. Professor Phillips (of the University of Witwatersrand) warned the audience of the effects of planting certain water-demanding trees in a country like South Africa. He stated that great care was needed where water supply was of paramount importance as to what type of vegetation was used for the conservation of that water. He directed pointed attention to the exotics and specially in the case of eucalyptus, and possibly acacias, and to a less extent in the case of pines laid emphasis that planting should be done only if full knowledge of the subject was available. Various other members including Mr. E. A. Garland from India took part in the discussion. It is not necessary to go into all the statements which were made in the Conference—they all more or less bear out the general statement that afforestation has a remedial influence on stream flow and on erosion. The President in winding up the debate remarked that erosion was due to the mismanagement of the soil—whether it be by destruction of forests by fire, by excessive grazing or whatever it might be. Therefore what we are concerned with is a reasonable management of the land whether it be forest, wattle land, agricultural or grazing land. If you can only have reasonable and proper management of the land surface problem, the problem of erosion would be solved. He remarked that one of the most important arguments which was put forward as supporting the contention for the benefit of forests was the remark of Mr. Thornton that trees diminish the force of winds and thus mitigate sheet erosion and slow down the water supply of a given area, and in irrigation matters that is of supreme importance.

At the end of the pamphlet there is an article on soil erosion in India and its consequences by Messrs. H. M. Glover and A. P. Hamilton. They have very clearly compared the pre-erosion condition of the Hoshiarpur Siwaliks with their present eroded condition and have enumerated various causes which have brought about this state of affairs. The report is a very instructive compilation of facts and has three plates showing in a very striking manner the changes brought about by erosion in certain places in India. [R. L. S.]

The Panjab Fruit Journal. **A quarterly organ published under the auspices of the Punjab Provincial Co-operative Fruit Development Board, Lyallpur. Annual subscription Rs. 2 inland and 4*s.* for foreign countries.**

It is an official organ of the Punjab Provincial Co-operative Fruit Development Board, published in two languages, *viz*, English and Urdu. The journal which is intended mainly to serve fruit-growing members of the Board is more than a mere chronicle of the activities of the Board and its affiliated district bodies. It aims at building up a fruit industry in the Punjab on scientific, economic and progressive basis by providing a much needed literature for disseminating the latest ideas on fruit culture and fruit industry in as non-technical a language as possible. The journal is issued under the personal guidance of the Fruit Specialist, Punjab, Lyallpur. The third quarter issue published in September contains eleven articles in English and about the same number in Urdu covering various important aspects of the fruit industry, such as danger of over-production of fruit in the Punjab, preparation of tomato juice, the Lahore fruit market, nitrogen carrying fertilisers, propagation of stone fruits, manuring of oranges, and seasonal hints, etc. There is an extreme paucity of literature on fruit gardening in popular languages of the country and this periodical being perhaps the first of its kind will be found very useful by the public interested in fruit culture. [R. L. S.].

Better Villages. By F. L. Brayne, Commissioner for Rural Reconstruction, Punjab. (Oxford University Press, Bombay, 1937.) Price Rs. 2.

The book gives an illustrated account of the activities of the rural development in the Punjab, pointing out briefly and in a most simple form what has been done and how it should be done. It is Mr Brayne's latest book combining the imagination of a practical idealist with the constructive planning of a reformer who has moved amongst the masses and stirred them with a new gospel. The book is intended for the lay workers—official or non-official—and only contains what every intelligent person living or working in a village should know for his own and his neighbours' well-being. The text covers a wide range of subjects such as home and village, the farm, the improvement of cattle, health, women's duties, village organization, co-operation, school, district organizations, publicity, rural finance, crime and faction in villages, and various side-lines of occupations useful for village. An interesting account of various items such as the capital, water supply, manure, good seed, strong cattle, fodder problems, crop diseases and pests, is given under farming. Cattle are as important as crops for the health and wealth of the villager, whether working the land, carrying the crops to the market or feeding the children. Formation of cattle breeding societies

is advocated and the programme of work which they should look to is described. Women's work and how to uplift them is given special attention. Upon the housewife's knowledge, thrift and skill depends the feeding, clothing, health, comfort and happiness of the home and greatest of all upon her capacity for bringing up and training the children depends the whole future of the State. The author advocates a women's institute in every village which should radiate light and guidance into the homes of the villagers. The standard of living is the standard of the home and in all parts of the countries it is the women, the housewife or the *gharwali* upon whom the home principally depends. A chapter is devoted to village organization which gives an account of village organizations, *e.g.*, the *punchayats*, the co-operative societies, etc., and what they can do in improving matters in villages. Great stress is laid on the spirit of co-operation and formation of co-operative societies such as better living societies, cattle breeding societies, arbitration societies, consolidation of holdings societies, industrial societies, etc., is strongly advocated. It is the ideal method for a poor and debt-ridden country of small holdings to raise the indebted peasantry. Co-operation is not merely a matter of registration and entrance fees. It begins in the heart. And until it begins there it can never hope to be a success. A visit to the villages, where the latest method of consolidation is in vogue, is an inspiration. An account of village school, what it should be like and what and how the village boys should be taught, is given. Attention is also devoted to district organizations and it is stated that to produce the best results in rural work the district requires organization just as much as the village. Experiment and experience have produced two co-ordinating bodies—inter-departmental committees for the officers' board, and the district community council now called the *Dihat Sudhar* Committee. They are working in close contact with each other and have been of immense benefit to the district. *Dihat Sudhar* Committee is the centre where the co-operation between the Government and the people can be best organized. The *Dihat Sudhar* Committees and Village Councils and co-operative societies afford an excellent means of teaching and developing methods on which the success of democratic institutions depends. Methods of publicity such as wireless, broadcasting, magic lanterns and cinemas, dramas, books, coloured pictures, models, public meetings, etc., and the relative merits of each are explained. The money-lending methods and rural finance like farming methods are generally out of date and require modernizing The village finance requires a complete overhaul. The system of finance most suitable for small holders is explained. The author deals with the causes of crime and faction and gives his ideas as to how to improve matters. Subsidiary occupations such as poultry, dairying, vegetable and fruit-growing, sheep and wool production, goat keeping, horse and mule breeding, bee keeping, silk and lac production, handicrafts like tanning, leather work, rope and string making, basket work, spinning, weaving, dyeing, printing, wood work, etc., are described. The problem of erosion and the remedial measures are also briefly

noted. The dangers of allowing the children to wear ornaments, the waste caused by burning manures as fuel, the use of quinine for checking malaria, and a note on urban uplift are also given in a chapter under Miscellaneous Subjects. The book furnishes a complete guide to rural reconstruction and should prove a very handy and readable treatise on the subject. [R. L. S.].

A Note-book of Tropical Agriculture. Compiled by R. Cecil Wood, Professor of Agriculture, Imperial College of Tropical Agriculture, Trinidad, 1937. Published by the Imperial College of Tropical Agriculture, Trinidad.

THIS is the second edition of this useful note-book. In this publication an endeavour has been made to present to readers simple facts and figures regarding the more important subjects connected with agricultural science in the form of a small book which may be conveniently carried about for reference. The book is interleaved. The contents cover a wide range of subjects such as buildings and roads, machinery, labour, soils, manures, crops, foods and feeding, live-stock, dairying, etc. The methods of measuring different sizes of areas which form now-a-days a necessary accompaniment of statistical work and are an essential feature of experimental agricultural work are explained by examples. Information is given of labour which is required for different farm operations. Analysis of various manures, both organic and inorganic, the average dose for different crops, unit prices and useful factors for converting nitrogen into ammonia, phosphoric acid to tetra-calcic phosphate (slag) and potash into different forms of potassium, etc., and manurial ingredients removed from the soil by different crops are given. In the chapter on crops useful information such as seed-rate, bushel rate, percentage of husk to grain, number of seeds in a pound, yield and other points are noted. The composition of different foods and feeding stuffs in common use by human beings and stock, which form so essential a feature of the present-day nutritional problems and the importance of which is pointed out by Sir John Russel in his recent report, are given. Composition and calculation of rations for different types of animals, *e.g.*, work bullock, milch and dry cows, poultry, etc., are included. The science of breeding and raising of live-stock, including sheep, goats, poultry, is briefly explained. A chapter is devoted to dairying where useful data concerning scientific handling of milk and its products and their analysis is noted. Recipes of common use on farm, *e.g.*, insecticides, fungicides, sprays, weed-killers, and inks for zinc labels are described. A few important points about statistics, *e.g.*, standard deviation, analysis of variance and tables of "*t*" and "*z*" are given. In the last chapter current prices for 1937 of crops, fruits, seeds, and manures, etc., names of institutions of service to agriculturists in the Tropics briefly describing their constitutions and aims are noted. The data given are required almost every day by agricultural workers and the book is thus likely to prove a very handy note for ready reference. [R. L. S.].

NEW BOOKS

On Agriculture and Allied Subjects

The Potato : its Culture, Uses, History and Classification. By William Stuart. Fourth edition, revised. Demy 8vo. Pp. xvi+508. (Philadelphia and London : J. B. Lippincott Co., 1937.) Price 12*s*. 6*d*. net.

Bacteriology : a Text-book of Micro-organisms. By Fred Wilbur Tanner. Third edition. Med. 8vo. Pp. xiii+510. (New York : John Wiley and Sons, Inc. ; London : Chapman and Hall, Ltd., 1937.) Price 17*s*. 6*d*. net.

An Introduction to Weather and Climate. By Glenn T. Trewartha. Pp. 373. Illustrated. (McGraw-Hill Series in Geography). (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C. 2.) Price 18*s*. net.

Food Technology. By Samuel C. Prescot and Bernard E. Proctor. Pp. 630. Illustrated. (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C. 2.) Price 30*s*. net.

Economic Botany. By Albert F. Hill. Pp. 592. 225 illustrations. (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C. 2.) Price 24*s*. net.

A Pocket-book of British Trees. By E. H. B. Boulton. Sup. Roy. 16mo. Pp. 182 (82 Plates). (London : A. and C. Black, Ltd., 1937.) Price 5*s*. net.

A Book of British Flora : for British Boys and Girls . By Mabel C. Coleclough. Demy 4to. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1937.) Price 5*s*. net.

Methods in Plant Physiology. By Walter E. Loomis and Charles A. Shull. Pp. 472. 92 illustrations. (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C. 2.) Price 25*s*. net.

Soils. Their Origin, Constitution and Classification. An Introduction to Pedology. By G. W. Robinson. 2nd edition. (Thomas Murby and Co., 1 Fleet Lane, London, E.C. 4, 1936.) Price 20*s*. net.

Insects of the British Woodlands. By R. Neil Chrystal. 12 half-tone plates, 12 line drawings and text illustrations. (Frederick Warne and Co., Ltd., Chandos House, Bedford Court, Bedford Street, Strand, London, W. C. 2.) Price 7*s*. 6*d*. net.

The Design and Analysis of Factorial Experiments. By F. Yates. Pp. 96. (The Imperial Bureau of Soil Science, Harpenden Herts.) Price 5*s*.

Colloid Systems. A Survey of the Phenomenon of Modern Colloid Physics and Chemistry. By A. Von Buzagh. Translated by Otto B. Darbishire. Roy. 8vo. Pp. 332 and 68 illustrations, 18 tables. (5 Ave Maria Lane, Ludgate Hill, London, E.C. 4.) Price 30*s*. net.

The Chromosomes. By M. J. D. White. F'cap, 8vo. with 18 diagrams. (Methuen, 36, Essex Street, London, W.C. 2.) Price 3*s*. 6*d*. net (in the Press).

The Pig Breeders' Annual for 1937-38. Issued by the National Pig Breeders' Association, London. (Obtainable from the National Pig Breeders' Association, Victoria House, Southampton Row, London, W.C. 1.)

The Thyroid and its Diseases. By J. H. Means. Pp. 602. (London : J. B. Lippincott Company, 1937.) Price 25*s*.

The Avitaminoses—Chemical, Clinical and Pathological Aspects of the Vitamin Deficiency Diseases. By Walter H. Eddy and Gilbert Dalldorf. Pp. 338. (London : Bailliere, Tindall and Cox, 1937.) Price 20*s*.

Ultraviolet Light and Vitamin D in Nutrition. By Katharine Blunt and Ruth Cowan. (Cambridge University Press, Fetter Lane, London, E.C. 4). Price 11*s*. 6*d*. net.

The Newer Knowledge of Bacteriology and Immunology. Edited by E. O. Jordan and I. S. Falk. (Cambridge University Press, Fetter Lane, London, E.C. 4.) Price 45*s*. net.

The Variation of Animals in Nature. By G. C. Robson and O. W. Richards. Pp. 425. (London, Toronto, and New York : Longmans, Green and Co., 1936.) Price $8.25.

Chemical Embryology. By Joseph Needham. Three vols. (Cambridge University Press, Cambridge.) Price £5 5*s*. net.

A History of Embryology. By Joseph Needham (Cambridge University Press, Cambridge.) Price 15*s*. net.

Poultry Breeding and Management—a Guide to every Branch of Poultry-Culture. By William W. Broomhead. (The New Era Publishing Co., Ltd., 12-14, Newton Street, High Holborn, London, W.C. 2.)

Atlas of Haematology. By Edwin E. Osgood and Clarice M. Ashworth. Pp. 255. (San Francisco : J. W. Stacey, Inc. London : H. K. Lewis and Co., 1937.) Price 45*s*.

An Outline of General Physiology. By L. V. Heilbrunn. Pp. 603. (London : W. B. Saunders Co., 1937.) Price 21*s*.

Recent Advances in the Study of Rheumatism. By Frederick, John Poynton and Bernard Schlesinger. Pp. 380. (London : J A. Churchill, 1937.) Price 15*s*.

Physiology and Pathology of the Heart and Blood-vessels. By John Plesch. Pp. 188. (London : Humphrey Milford, Oxford University Press, 1937.) Price 15*s*.

Practical Veterinary Pharmacology, Materia Medica and Therapeutics. By H. J. Milks. Third edition. (London : Bailliere, Tindall & Cox) Price 30*s*.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

BRITISH INDIA

Notification No. F. 313-37-A., dated the 26th August 1937, issued by the Government of India in the Department of Education, Health and Lands.

In the form of certificate, published in this Department notification No. F. 320/35-A., dated the 20th July 1936, to accompany consignments of plants intended for export from India the following amendment shall be made :—

For the words, " the plant(s) living plant(s) or plant products ".

Read : " the plant(s) living plant(s) or plant products
a representative sample of the plant(s) living plant(s) or plant products."

* * *

Notification No. D. 2715-4/37, dated the 21st October 1937, issued by the Government of India in the Department of Education, Health and Lands.

In exercise of the powers conferred by sub-section (*1*) of section 3 of the Destructive Insects and Pests Act, 1914 (II of 1914), the Central Government is pleased to direct that the following further amendment shall be made in the order published with the Government of India, Department of Education, Health and Lands Notification No. F. 320/35-A, dated the 20th July 1936, namely :—

In the second proviso to paragraph 4 of the said order for the letters and words " Mr. M. K. Seetharama Chetty " and " Mr. Seetharama Chetty " the letters and words " Dr. L. S. Doraswami " and " Dr. Doraswami " shall be substituted respectively.

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Notification No. F. 46-4/37-A., dated the 3rd November 1937, issued by the Government of India in the Department of Education, Health and Lands.

It is notified for general information that the expression "plant" wherever it occurs in this Department notification No. 360, dated the 29th February 1924 and in those issued subsequently, amending or amplifying it, includes fruit.

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

Imperial Council of Agricultural Research

On return from deputation *ex*-India, SIR BRYCE C. BURT, C.I.E., M.B.E., B.Sc., I.A.S., resumed charge of the office of Vice-Chairman, Imperial Council of Agricultural Research, with effect from the 29th October 1937, relieving MR. N. C. MEHTA, I.C.S.

MR. N. C. MEHTA, I.C.S., and KHAN SAHIB BAZLUL KARIM reverted to their substantive appointments of Secretary, Imperial Council of Agricultural Research and Superintendent, Imperial Council of Agricultural Research Department, respectively, with effect from the 29th October 1937.

MR. H. B. SHAHI, M.Sc., M.R.C.V.S., D.T.V.M., has been appointed Assistant Animal Husbandry Expert, Imperial Council of Agricultural Research, with effect from the 8th November 1937.

The Government of the United Provinces have re-nominated MR. T. J. EGAN, I.V.S., Director of Veterinary Services, United Provinces, as the representative of the United Provinces Veterinary Department on the Imperial Council of Agricultural Research, with effect from the 17th September 1937, on which date he relinquished his previous membership of the Council.

The Indian Research Fund Association has re-elected COLONEL A. J. H. RUSSELL, C.B.E., K.H.S., I.M.S., to be its representative on the Imperial Council of Agricultural Research, with effect from the 13th February 1937, on which date he relinquished his previous membership of the Council.

His Excellency the Governor-General-in-Council has been pleased to appoint the DIRECTOR OF DEVELOPMENT, ORISSA, as a member of the Imperial Council

of Agricultural Research and of its Advisory Board, *vice* the DEPUTY DIRECTOR OF AGRICULTURE and the ASSISTANT DIRECTOR OF VETERINARY SERVICES, ORISSA, resigned.

His Excellency the Governor-General-in-Council has been pleased to appoint the HON'BLE MINISTER FOR AGRICULTURE IN ORISSA as a member of the Imperial Council of Agricultural Research and of its Governing Body.

The services of MR. N. B. BONARJEE, I.C.S., have been replaced at the disposal of the Government of the United Provinces, with effect from the afternoon of the 2nd October 1937.

MR. ANDREW WILSON, I.A.S., Madras, has been appointed Special Officer, Cinchona Enquiry under the Imperial Council of Agricultural Research, with effect from the 14th October 1937.

DR. T. J. MIRCHANDANI, M.SC., PH.D., has been appointed Soil Chemist, Cinchona Enquiry, with effect from the forenoon of 5th November 1937.

Imperial Institute of Sugar Technology

MR. A. R. KHAN, Assistant Sugar Technologist, Imperial Institute of Sugar Technology, has been granted leave on average pay for two months and fifteen days, with effect from the 16th September 1937.

MR. S. N. GUNDU RAO, B.SC., a Laboratory Assistant in the Imperial Institute of Sugar Technology, has been appointed as Assistant Sugar Technologist, with effect from the 16th September 1937, *vice* MR. A. R. KHAN, granted leave.

MR. K. C. JOSHI, a Laboratory Assistant in the Imperial Institute of Sugar Technology, has been appointed as Chemist, Sugar Research and Testing Station, Bilari, under the Imperial Council of Agricultural Research, with effect from the 5th May 1937.

Indian Central Cotton Committee

DR. D. N. MAHTA, B.A. (Oxon.), F.L.S., of the Central Provinces and Berar Provincial Agricultural Service, Class I, has been appointed Secretary to the Indian Central Cotton Committee, with effect from the 4th October 1937.

MR. P. H. RAMA REDDI, M.A., B.Sc. (Agri.), B.Sc. (Forestry) (Edin.), Director of Agriculture, Madras, has been nominated by the Central Government to be a member of the Indian Central Cotton Committee, as the representative of the Madras Agricultural Department, *vice* RAO BAHADUR D. ANANDA RAO, resigned.

Indian Central Jute Committee

DR. N. N. LAW, M.A., PHD., of 8, Pretoria Street, Calcutta, has been nominated by the Bengal National Chamber of Commerce, Calcutta, to be a member of the Indian Central Jute Committee, *vice* the HON'BLE MR. N. R. SARKAR, resigned.

MR. G. EUTHYMOPULO of Messrs. Ralli Brothers, Limited, Calcutta, has been nominated by the Calcutta Baled Jute Association, to be a member of the Indian Central Jute Committee.

Indian Lac Cess Committee

The Central Government have been pleased to appoint SIR BRYCE BURT, C.I.E., M.B.E., B.Sc., I.A.S., Vice-Chairman of the Imperial Council of Agricultural Research, to be the President of the Indian Lac Cess Committee and to be the Chairman of its Governing Body and Advisory Board, with effect from the 29th October 1937, *vice* MR. N. C. MEHTA, I.C.S., resigned.

Imperial Agricultural Research Institute

MR. WYNNE SAYER, B.A., I.A.S., Imperial Agriculturist and Joint Director, Imperial Agricultural Research Institute, returned to duty on the 27th October 1937.

Madras

RAO BAHADUR D. ANANDA RAO, B.Sc. (EDIN.), has been granted leave on average pay for two months and twenty-six days from the 20th September 1937.

MR. T. BUDHAVIDHEYA RAO NAYUDU, L.AG., Deputy Director of Agriculture, Second Circle, on transfer, has been granted an extension of leave on average pay by one month from the 4th September 1937.

Bombay

RAO SAHEB B. P. WAGHOLKAR, Principal Agricultural Officer, Sugarcane Research Scheme for Deccan, Padegaon, has been granted leave on average pay for twenty-seven days, with effect from 1st November 1937.

MR. L. S. S. KUMAR, M.Sc. (Lond.), A.R.C.S., D.I.C., Economic Botanist to Government, has been granted leave on average pay for one month and fourteen days with effect from 5th August 1937.

Bengal

On return from leave, MR. DWIJADAS DUTTA, B.Sc. (Cal.), M.S.A. (Cornell), Second Economic Botanist, Bengal, has been appointed to act as Deputy Director of Agriculture, Northern Circle, *vice* MR. A. R. MALIK, appointed as Senior Marketing Officer, Bengal.

United Provinces

On return from leave, MR. C. MAYA DAS, M.A., B.Sc. (Edin.), I.A.S., Deputy Director of Agriculture, has been posted to Sarda Circle, Lucknow.

On relief by MR. C. MAYA DAS, M.A., B.Sc. (Edin.), I.A.S., MR. MAQSUD ULLAH S. JUNG, Dip. Agri., Assistant Director of Agriculture, has been posted as Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly.

On relief by MR. JUNG, MR. IMAM AHMAD, Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly, has been transferred to Western Circle, Aligarh, in the same capacity.

The following four officers employed in the Hill Fruit Research Scheme, Chaubattia, have been confirmed in their respective temporary posts mentioned against them, with effect from the 10th July, 1936.

1. DR. RAGHUNATH SAHAI GUPTA, M.Sc., Ph.D., A.I.C.—" Soil Chemist ".
2. MR. RAM NARAIN SINGH, L.Ag.—" Entomologist ".
3. MR. RAM SURAT SINGH, L.Ag., B.Sc. (Reading)—" Horticulturist ".
4. MR. UDAI BHAN SINGH.—" Mycologist ".

Punjab

MR. SULTAN ALI, I.A.S., Deputy Director of Agriculture, Rawalpindi, has been granted leave on average pay for six months, with effect from the 4th July 1937.

MR. MUKHTAR NABI, Extra Assistant Director of Agriculture, Rawalpindi, has been appointed in-charge of the duties of Deputy Director of Agriculture, Rawalpindi, with effect from the 4th July 1937, relieving MR. SULTAN ALI, granted leave.

DR. DALIP SINGH, M.Sc., Ph.D. (Cantab.), Second Agricultural Chemist, Lyallpur, has been granted leave on average pay for one month with effect from the 26th August 1937.

MR. HAQ NAWAZ KHAN, G.P.V.C., P.V.S., Class I, Professor of Physiology, Punjab Veterinary College, Lahore, has been granted leave on average pay for fifteen days, with effect from the 16th September 1937, combined with half the college vacation from the 1st August 1937 to the 15th September 1937.

Bihar

MR. ZARBAKHT KHAN, Horticulturist, Fruit Research Scheme, Sabour (Bhagalpur), has been granted earned leave for thirty days from the 20th October 1937.

DR. PABITRA KUMAR SEN has been appointed temporarily as Physiological Botanist under the Fruit Research Scheme, with effect from the 2nd September 1937, with headquarters at Sabour.

Assam

RAI BAHADUR J. N. CHAKRAVARTY, B.A., M.S. (Cornell), Dip. in Agri., I.A.S., Director of Agriculture, Assam, has been granted leave on average pay preparatory to retirement for two months and twelve days, with effect from the 1st September 1937.

DR. S. K. MITRA, M.S. (Calif.), Ph.D. (Ohio), I.A.S., Economic Botanist, Assam, has been appointed to the temporary post of Director of Agriculture, Assam, in Class I of the Assam Agricultural Service, with effect from the 1st September 1937.

MR. S. MAJID, B.Sc., Economic Botanist, Deep Water Paddy Farm, Habiganj, has been granted earned leave for sixteen days, with effect from the 16th August 1937 or any subsequent date on which he may avail himself of it.

North-West Frontier Province

MR. S. R. CHADHA, B.Sc. (Punjab), M.R.C.V.S. (England), Disease Investigation Officer, North-West Frontier Province, has been granted seventeen days' earned leave, with effect from the 2nd August 1937.

MR. SADRUDDIN AHMED, B.V.Sc. (Toronto), V.S. (Ontario), L.V.P. (Punjab), Veterinary Assistant Surgeon, Peshawar, has been appointed to officiate as Disease Investigation Officer, North-West Frontier Province, with effect from the 2nd August 1937, *vice* MR. S. R. CHADHA, B.Sc. (Punjab), M.R.C.V.S. (England), granted leave.

Sind

DR. B. T. MULWANI has been appointed as officiating Agricultural Chemist and Soil Physicist at the Agricultural Research Station, Sakrand, *vice* MR. M. A. SHAM IYENGAR, reverting to his substantive appointment.

Recent Publications of the Imperial Agricultural Bureaux

I. OBTAINABLE FROM THE IMPERIAL BUREAU OF SOIL SCIENCE, ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, HERTS

Periodical Abstracts

	s.	d.
List of publications and papers on Soil Science published in the Empire Overseas in—		
1933	1	0
1934	1	0
Soil Research in the British Empire published in 1935	1	0
Lists of Publications relating to Soils and Fertilisers—		
Published monthly, per annum, post free	10	0
Monthly Letters—		
Free to recipients, within the British Empire, of "Publications relating to Soils and Fertilisers". Subscription, outside the Empire, per annum	4	0
Recent Developments in Soil Analysis—		
Quarterly Supplement to the above publications. Separate copies, each	0	6

Occasional Papers

	s.	d.
Technical Communications—		
34. Tropical Soils in relation to Tropical Crops	2	6
Annual Report : For the year 1933-34	0	6
,, 1934-35	0	6
,, 1935-36	0	6
Bibliographies—		
Bibliography on Coffee	2	0
Catalogue of Journals and Periodicals in the Library of Rothamsted Experimental Station	2	0
Special Publication—		
The Katamorphism of Igneous Rocks under Humid Tropical Conditions (by the late Sir J. B. Harrison)	5	0
Bibliography of Soil Science, Fertilizers and General Agronomy, 1931-34	25	0

II. OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL HEALTH, VETERINARY RESEARCH LABORATORY, NEW HAW, WEYBRIDGE, SURREY

Abstracting Journal

	s.	d.
The Veterinary Bulletin—		
1931. Vol. 1. Quarterly (1st Number, April)	7	6
Annual subscription	20	0
Subsequent volumes. Monthly (1st Number, January)	5	0
Annual subscription (postage paid)	40	0

		s.	d.
	Indexing Publication		
Index Veterinarius.—Four issues a year. First issue, April 1933. Annual Subscription (postage paid). Volumes I to III mimeographed, Volume IV onwards printed		100	0

III. Obtainable from the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Bucksburn, Aberdeen

	Journal		
Nutrition Abstracts and Reviews. (Issued under the direction of the Imperial Agricultural Bureaux Council, the Medical Research Council and the Reid Library)—			
Subscription per volume of 4 numbers		42	0
Per single number		13	0
	Occasional Papers		
Technical Communications—			
6. The Composition of Certain African Foods and Feeding Stuffs		1	0
7. Wheat. Pre-eminence as a Cereal Food: Nutritive Value; Relation to Health and Disease		1	0
Occasional Communications—			
1. The Effect of Climate on the Composition of Pasture Plants		..	

IV. Obtainable from the Imperial Bureau of Plant Genetics (for crops other than Herbage), Plant Breeding Institute, School of Agriculture, Cambridge

	Journal		
Plant Breeding Abstracts—			
Quarterly. Annual subscription		15	0
Single copy		5	0
	Occasional Papers		
Indexes to Plant Breeding Abstracts—			
Subject Index to Vols. I to V of Plant Breeding Abstracts		5	0
Subject Index to Vol. VI of Plant Breeding Abstract		2	6
Supplements to Plant Breeding Abstracts—			
Summary of Reports received from Countries exclusive of the British Empire, 1928-31. Supplement I		2	6
Summary of Reports received from Stations in the British Empire, 1932-35. Supplement II		5	0
Technical Communications—			
Vernalization and Phasic Development of Plants, 1935 (Joint Publication of the Imperial Bureaux of Plant Genetics)		10	0
The South American Potatoes and their Breeding Value		3	6
Bibliographical Monographs—			
Breeding Resistant Varieties, 1930-33 (Supplement)		2	0
The Experimental Production of Haploids and Polyploids		5	0

V. OBTAINABLE FROM THE IMPERIAL BUREAU OF PLANT GENETICS (HERBAGE PLANTS), WELSH PLANT BREEDING STATION, AGRICULTURAL BUILDINGS, ALEXANDRA ROAD, ABERYSTWYTH, WALES

Journals

	s.	d.
Herbage Abstracts—		
Quarterly. Annual subscription	15	0
Single number	5	0

Herbage Reviews—

Subscription is at present—Vol. 1 (1933), Vol. 2 (1934), Vol. 3 (1935), Vol. 4 (1936)—included in that to Herbage Abstracts.

Occasional Papers

	s.	d.
Bulletins—		
18. Pastures and Forage Crops in South Africa	3	0
19. Production of Grass Seed	5	0
20. Insects and other Pests Injurious to the Production of Seed in Herbage and Forage Crops	2	6
21. The Influence of Climatic Conditions on Type Composition . .	1	0
22. Technique of Grass Seed Production at the Welsh Plant Breeding Station	5	0
23. Production of Legume Seed	5	0
24. Collection of Native Grass Seed in the Great Plains, U. S. A. .	2	0

VI. OBTAINABLE FROM THE IMPERIAL BUREAU OF FRUIT PRODUCTION, EAST MALLING RESEARCH STATION, EAST MALLING, KENT

Journal

Horticultural Abstracts—

A quarterly abstract publication of current horticultural literature—

	s.	d.
Annual subscription	15	0
Single copy	4	0

Technical Communications

	s.	d.
7. Vegetative Propagation of Tropical and Sub-tropical Fruits, 1936. J. St. Clair Feilden and R. J. Garner	2	0
8. Horticultural Aspects of Woolly Aphis Control together with a Survey of the Literature, 1936. R. M. Greenslade	2	6

Occasional Papers

	s.	d.
3. Annotated Bibliography on Bitter-Pit, 1934	1	6
4. Recent Work of Tropical and Sub-Tropical Interest . . .	0	6

	s.	d.
Other Publications—		
Index to Volumes I-X of the *Journal of Pomology and Horticultural Science*, 1933. Compiled by Bureau, published by the Editors of the *Journal of Pomology and Horticultural Science.* Available from the Bureau	5	0
Old and New Standpoints on Senile Degeneration, 1931. A. P. C. Bijhouwer	0	6
Fruit Growing in the Empire. Standardisation of Horticultural Material with special reference to Rootstocks, 1927. R. G. Hatton. Being unnumbered Empire Marketing Board Publication. (Free).		
Viticultural Research, 1928. D. Akenhead. Being Empire Marketing Board Publication 11	1	0

VII. Obtainable from the Imperial Bureau of Animal Genetics, Institute of Animal Genetics, University of Edinburgh, King's Buildings, West Mains Road, Edinburgh

Journal

Animal Breeding Abstracts (quarterly), commencing April, 1933. Annual subscription	15	0

Occasional Papers

Bibliography of the Works of J. C. Ewart (free to subscribers of Animal Breeding Abstracts, Vol. 1), 1934	0	6
Animal Breeding in the British Empire. A Survey of Research and Experiment, 1934	2	0

VIII. Obtainable from the Imperial Bureau of Agricultural Parasitology, Institute of Agricultural Parasitology, Winches Farm Drive, Hatfield Road, St. Albans, Herts

Journal

Bibliography of Helminthology. For the year 1933—		
Library Edition, bound in cloth	10	6
Stiff paper cover only	8	0
Helminthological Abstracts (1932 onwards). Issued in five or six parts per volume, each volume covering the literature of a single year. Subscription per volume, payable in advance	30	0
Completed volumes, bound in cloth	32	0

Occasional Papers

(i) The Effects of some Natural Factors on the Second Ecdysis of Nematode Infective Larvae. G. Lapage	4	0
Notes and Memoranda—		
11. Recent Developments in the Control of *Heterodera marioni* . .	1	6

PUBLICATIONS OF THE IMPERIAL COUNCIL OF AGRICULTURAL RESEARCH, INDIA

(Prices are inclusive of packing and Indian postage)

1. Agriculture and Live-stock in India

ICAR. 1. A bi-monthly journal of agriculture and animal husbandry for the general reader interested in agriculture or live-stock in India or the Tropics. (Established 1931. Published in January, March, May, July, September and November. Prepayable subscription Rs. 6 or 9*s*. 9*d*. per annum. Price per part Rs. 2 or 3*s*. 6*d*.) Volumes I to VII complete are available

2. The Indian Journal of Agricultural Science

ICAR. 5. A bi-monthly scientific journal of agriculture and the allied sciences, mainly devoted to the publication of the results of original research and field experiments. (Established 1931. Published in February, April, June, August, October and December. Prepayable subscription Rs. 15 or 24*s*. per annum. Price per part Rs. 3 or 5*s*. 3*d*.) Volumes I to VII complete are available.

3. The Indian Journal of Veterinary Science and Animal Husbandry

ICAR. 6. A quarterly journal for the publication of scientific matter relating to the health, nutrition and breeding of live-stock. (Established 1931. Published in March, June, September and December. Prepayable subscription Rs. 6 or 9*s*. 9*d*. Price per part Rs. 2 or 3*s*. 6*d*.) Volumes I to VII complete are available.

4. Scientific Monographs of the Imperial Council of Agricultural Research

ICAR. 10·1. No. 1. The Fungi of India By E. J. Butler, C.I.E., D.Sc., M.B., F.R.S. and G. R. Bisby, Ph.D. (1931). Price Rs. 6-12-0 or 11*s*.

ICAR. 10·2. No. 2. Life-histories of Indian Microlepidoptera, Second Series : Alucitidae (Petrophoridæ, Tortricina and Gelechiadæ). By T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S. (1932). Price Rs. 3-4-0 or 5*s*. 6*d*.

ICAR. 10·3. No. 3. The Open Pan System of White-Sugar Manufacture. By R. C. Srivastava, B.Sc. (1935, 2nd edition.) Price Rs. 3-2-0 or 5*s*. 6*d*.

ICAR. 10·4. No. 4. Life-histories of Indian Microlepidoptera : Cosompterygidæ to Neopseustidae. By T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S. (1933). Price Rs. 4-8-0 or 7*s*. 6*d*.

ICAR. 10·5. No. 5. The Bombay Grasses. By E. J. Blatter, S. J., Ph.D., F.L.S. and C. McCann, F.L.S. Illustrated by R. K. Bhide. Price Rs. 20-12-0 or 32*s*. 6*d*.

ICAR. 10·6. No. 6. Helminth Parasites of the Domesticated Animals in India. By G. D. Bhalerao, M.Sc. Price Rs. 7-12-0 or 13*s*. 3*d*.

ICAR. 10·7. No. 7. Influence of Manures on the Wilt Disease of *Cajanus indicus* Spreng. and the Isolation of Types Resistant to the Diseases. By W. McRae, M.A., D.Sc. (Edin.), F.L.S. and F. J. F. Shaw, D.Sc. (Lond.), A.R.C.S., F.L.S. (1933). Price Rs. 2-4-0 or 4*s*. 3*d*.

ICAR. 10·8. No. 8. The Silk Industry of Japan with Notes on Observations in the United States of America, England, France and Italy. By C. C. Ghosh, B.A., F.E.S. (1933). Price Rs. 4 or 6*s*. 9*d*.

ICAR. 10·9. No. 9. Mechanical Cultivation in India. A History of the Large-Scale Experiments carried out by Burmah-Shell Oil Storage and Distributing Company of India, Ltd. By C. P. G. Wade. Price Rs. 3-14-0 or 6*s*. 6*d*.

ICAR. 10·10. No. 10. The Spotted Boll-Worms of Cotton (*Earias fabia* Stoll and *Earia insulana* Boisd) in South Gujarat, Bombay Presidency. (Final report on investigations financed by the Indian Central Cotton Committee, 1923-1931). By B. P. Deshpande, M.Ag. and N. T. Nadkarny, B.Ag. Price Rs. 5-14-0 or 9*s*. 6*d*.

ICAR. 10·11. No. 11. Investigations on the Course and Distribution of the Nerves supplying Levator anguli scapuli and Rhomboideus muscles and the Formation of the Phrenic Nerve in the Ox, with Observations on certain Anatomical Deviations. By H. N. Chelva Ayyangar, G.M.V.C. Price Rs. 4-10 or 7*s*. 9*d*.

5. Miscellaneous Bulletins of the Imperial Council of Agricultural Research

ICAR. 8·1. No. 1. List of Publications on Indian Entomology (1930). Compiled by the Imperial Entomologist, Pusa. Price As. 14 or 1*s*. 6*d*.

ICAR. 8·2. No. 2. List of Publications on Indian Entomology (1931). Compiled by the Imperial Entomologist, Pusa. Price As. 8 or 10*d*.

ICAR. 8·3. No. 3. List of Publications on Indian Entomology (1932). Compiled by the Imperial Entomologist, Pusa. Price As. 12 or 1*s*. 3*d*.

ICAR. 8·4. No. 4. Host Plant Index of Indo-Ceylonese Coccidae. By S. Ramachandran, L.Ag. and T. V. Ramakrishna Ayyar, B.A., Ph.D., F.Z.S. Price Rs. 1-10 or 2*s*. 9*d*.

ICAR. 8·5. No. 5. List of Publications on Indian Entomology (1933). Compiled by the Officiating Imperial Entomologist, Pusa. Price As. 9 or 1*s*.

ICAR. 8·6. No. 6. Bee-keeping. By C. C. Ghosh, B.A., F.R.E.S. (3rd Edition.) Price Rs. 1-14 or 3*s*. 3*d*.

ICAR. 8·7. No. 7. List of Publications on Indian Entomology (1934). Compiled by the Imperial Entomologist, Pusa. Price Rs. 1-2-0 or 2*s*

ICAR. 8·8. No. 8. Selected Clinical Articles, Part I, By G. K. Sharma and R. L. Kaura. Price As. 8 or 10*d*.

ICAR. 8·9. No. 9. Statistical Methods and their Application to Agronomy: A Bibliography. Compiled by K. K. Guha Roy, B.A. Price Rs. 2-2 or 4*s*.

ICAR. 8·10. No. 10. Diseases of Sugarcane and Methods for their Control. By L. S. Subramaniam. Price Re. 1-14 or 3*s*. 3*d*.

ICAR. 8·11. No. 11. Tables of Standard Errors of Mendelian Ratios. Compiled by Swarn Singh Purewal, M.Sc., Ph.D. and Krishna Rao, L.Ag. Price As. 12 or 1*s*. 3*d*.

ICAR. 8·12. No. 12. List of Publications on the Botany of Indian Crops, Part II, for the period 1928-32. Compiled by R. D. Bose, B.Sc. Price Rs. 3-6-0 or 5*s*. 9*d*.

ICAR. 8·13. No. 13. Two New Statistical Tables based upon Fisher's '*t*'. By M. Vaidyanathan, M.A. Price As. 6 or 8*d*.

ICAR. 8·14. No. 14. List of Publications on Indian Entomology (1935) Compiled by the Imperial Entomologist, Pusa. Price Re. 1-4 or 2*s*.

ICAR. 8·15. No. 15. Selected Clinical Articles, Part II. By G. K. Sharma; R. L. Kaura; S. Ganapathy Iyer; G. S. Khan and M. Y. Mangrulkar. Price Re. 1-4-0 or 2*s.*

ICAR. 8·16. No. 16. Indian Grazing Conditions and the Mineral Contents of some Indian Fodders. By P. E. Lander, M. A., D.Sc., F.I.C., I.A.S. Price Rs. 3-14-0 or 6*s.* 9*d.*

6. Annual Report of the Imperial Council of Agricultural Research

ICAR. 12·31. Annual Report of the Imperial Council of Agricultural Research for the years 1929-30 and 1930-31. Price As. 12 or 1*s.* 3*d.*

ICAR. 12·32. Annual Report of the Imperial Council of Agricultural Research for the year 1931-32. Price As. 6 or 8*d.*

ICAR. 12·33. Annual Report of the Imperial Council of Agricultural Research for the year 1932-33. Price As. 6 or 8*d.*

ICAR. 12·34. Annual Report of the Imperial Council of Agricultural Research for the year 1933-34. Price Re. 1-8 or 2*s.* 6*d.*

ICAR. 12·35. Annual Report of the Imperial Council of Agricultural Research for the year 1934-35. Price Re. 1 or 1*s.* 9*d.*

ICAR. 12·36. Annual Report of the Imperial Council of Agricultural Research for the year 1935-36. Price As. 14 or 1*s.* 6*d.*

ICAR. 12·37. Annual Report of the Imperial Council of Agricultural Research for the year 1936-37. Price Re. 1-2 or 2*s.*

7. Agriculture and Animal Husbandry in India (called Review of Agricultural Operations in India upto 1933)

ICAR. 9·29. Review of Agricultural Operations in India, 1928-29. Price Rs. 3-2-0 or 5*s.* 6*d.*

ICAR. 9·31. Review of Agricultural Operations in India, 1929-31. Price Rs. 5 or 8*s.* 3*d.*

ICAR. 9·33. Review of Agricultural Operations in India, 1931-33. Price Rs. 5-12-0 or 9*s.* 6*d.*

Agriculture and Animal Husbandry in India, 1933-34 and 1934-35.

ICAR. 13·1·35. Part I. Crop Production. Price Rs. 4-14-0 or 8*s.*

ICAR. 13·2·35. Part II. Animal Husbandry. Price Re. 1 or 1*s.* 9*d.*

ICAR. 13·36. Agriculture and Animal Husbandry in India, 1935-36. Price Rs. 4-10 or 7*s.* 9*d.*

8. Proceedings of the Board of Agriculture and Animal Husbandry

ICAR. 2. Proceedings of the First Meeting of the Animal Husbandry Wing of the Board of Agriculture and Animal Husbandry held at New Delhi from the 20th to the 23rd February 1933, with Appendices. Price Rs. 5-14-0 or 9*s.* 6*d.*

ICAR. 3. Proceedings of the First Meeting of the Crops and Soils Wing of the Board of Agriculture and Animal Husbandry in India held at Delhi from the 25th February to the 2nd March 1935, with Appendices. Price Rs. 6 or 9*s.* 9*d.*

9. Miscellaneous

VRI. 1. A Description of the Imperial Institute of Veterinary Research, Muktesar, and its Sub-station the Imperial Veterinary Serum Institute, Izatnager. By F. Ware, F.R.C.V.S., I.V.S. Price Rs. 1-4-0 or 2*s.*

ARI. 7·187. The Production of Cigarette Tobacco by Flue-curing. By F. J. F. Shaw, C.I.E., D.Sc., A.R.C.S., F.L.S. and Kashi Ram. *Imp. Inst. Agric. Res. Pusa Bull.* No. 187. Reprinted (1935). Price Re. 1 or 1*s.* 9*d.*

ICAR. 16. A Handbook of Statistics for use in Plant Breeding and Agricultural Problems. By F. J. F. Shaw, C.I.E., D.Sc., A.R.C.S., F.L.S. Price Rs. 4-6-0 or 7s. 3d.

ICAR. 7. Report on the work of the Imperial Council of Agricultural Research in applying science to Crop Production in India. By Sir John Russell, D. Sc., F. R. S. Price Rs. 1-14 or 3s. 3d.

ICAR. 18. Report on the Development of the Cattle and Dairy Industries of India. By Norman C. Wright, M.A., D.Sc., Ph.D. Price Rs. 1-8-0 or 2s. 6d.

Copies of the above publications can be had from the Manager of Publications, Civil Lines, Delhi, and from any of the Agents, a list of whom will be found on the inside page of the front cover. Prices are inclusive of packing and Indian postage.

Purchasers not residing in Asia should apply to the High Commissioner for India, India House, Aldwych, London.

NOTE :—When indenting please give only the symbol preceding the name of the publication.

APPENDIX

Instructions to Authors of Publications of the Imperial Council of Agricultural Research*

1. All manuscripts should be clean, clear and carefully revised. Only one side of the paper should be used, and as far as practicable the original type-written copy and not a carbon copy should be sent. Capitals should be sparingly used, and all the necessary punctuations should be done in the MS. and not left for introduction in proofs.

2. The title of a paper should not be lengthy.

3. It is desirable that MS. should have suitable heads and sub-heads. In numbering the principal divisions of a paper Roman numerals should be used. The use of Arabic figures and (*a*), (*b*), (*c*), etc., is generally reserved for numbering the sub-divisions coming under each head.

4. Articles submitted for publication either in the *Indian Journal of Agricultural Science* or in the *Indian Journal of Veterinary Science and Animal Husbandry* should be accompanied by abstracts for publication in *Agriculture and Live-stock in India*. Abstracts should be concise, but should be long enough to explain the matter dealt with ; ordinarily no abstract should exceed 200 words.

5. When a word or line is intended to be printed in *italics* it should be underlined with a single line, in SM. CAP. with two lines, in CAPITALS with three lines, and when in **Antique** (heavy type) with a wavy line (~~~~~~~~~~).

6. In descriptive matter, numbers under 100 and all numbers occurring at the beginning of a sentence should be in words.

7. Local names for crops, technical operations, etc., should be defined where they first occur in the text, *e.g.*, *rabi* (spring crop). The use of local weights and measures should be avoided as far as possible. Vernacular names, such as *jowar*, *bajri*, should be in italics without a capital letter, and each such name where it first occurs should be followed by its scientific equivalent in brackets, *e.g.*, *jowar* (*Andropogon Sorghum*). It is usual to write the initial letters of varietal names in capitals, *e.g.*, Striped Mauritius, Dharwar-American cotton and Broach cotton.

8. Botanical and zoological names are printed in italics and should be underlined in the MS., *e.g.*, *Triticum vulgare* L. ; *Diplodia Corchori* Syd. ; *Pyrilla aberrans*

*Spare copies of these Instructions can be had on application to the Secretary, Imperial Council of Agricultural Research (Publication Section), New Delhi.

Kirby. The International Rules of Botanical Nomenclature and the International Rules of Zoological Nomenclature should be followed. The names of chemical substances should not be written with a capital letter; they are printed in roman type (*e.g.*, calcium carbonate, prussic acid).

9. The following and similar abbreviations may be used freely —*viz.*, *e.g.*, *i.e.*, mm. (millimetre), cm. (centimetre), grm. (gramme), mg. (milligramme), c.c. (cubic centimetre), sp. gr. (specific gravity), lb. (pound), cwt. (hundredweight), in. (inch), ft. (foot), oz. (ounce), md. (maund), sr. (seer), ch. (chattack). Other abbreviations should be used sparingly, if at all.

10. References to plates should be given within brackets, without prefixing the word "see" or "cf.", in the MS. itself, and should not be left over for introduction in proofs. For example, "The parasite (Plate X, fig. 4) was present late in 1906".

11. The word "Table" is preferable to "Statement", and tables should be numbered consecutively in roman figures. Each table should have an explanation as a sub-head. It is more convenient for reference if tables can be printed horizontally; for this purpose they should not exceed in width the printing measure of the page (5 in.). *Example*—

TABLE IV

Results of water-saving experiments on wheat (Pusa 12) at Gungapur, Haripur and Sargodha, 1916-17

Station	No. of irrigations including the preliminary watering	Yield per acre in maunds and seers		Average yield per acre	
		Grain	Straw	Grain	Straw
		Mds. Srs.	Mds. Srs.	Mds. Srs.	Mds. Srs.
Gungapur . . .	One	12 19½	20 10	9 34	21 17
Haripur . . .	"	8 31	19 14		
Sargodha . . .	"	8 12½	25 27½		

12. References to literature, arranged alphabetically according to authors' names, should be placed at the end of the article, the various references to each author being arranged chronologically. Each reference should contain the name of the author (with initials), the year of publication, the abbreviated title of the publication, volume and page. In the text the reference should be

indicated by the author's name followed by the year of publication enclosed in brackets; when the author's name occurs in the text, the year of publication only need be given in brackets. If reference is made to several articles published by one author in a single year, these should be numbered in sequence and the number quoted after the year both in the text and in the collected references. This system of referencing is the same as is used in the *Biochemical Journal* with slight modification and will be clear from the following illustration:—

The work of Osborne and Mendel [1919, 1, 2] and Steenbock and Boutwell [1919] had indicated an association of the fat-soluble vitamin with the green parts of plants. This view was examined by Coward and Drummond [1921] who reported that vitamin A was not synthesised by etiolated shoots but that green leaves were active in its formation. Another worker [Wilson, 1922], on the other hand, found that etiolated shoots if given in sufficient quantity could supply the fat-soluble vitamin and that this factor was therefore formed in the absence of light.

REFERENCES

Coward, K. H. and Drummond, J. C. (1921). *Biochem. J.* **15**, 530.
Osborne, T. B. and Mendel, L. B. (1919, 1). *J. Biol. Chem.* **37**, 187.
——— ——— (1919, 2). *J. Biol. Chem.* **41**, 549.
Steenbock, H. and Boutwell, R. (1919). *J. Biol. Chem.* **41**, 149.
Wilson, J. (1922). *J. Biol. Chem.* **51**, 455.

Abbreviations, as far as possible, should follow the system adopted in "A World List of Scientific Periodicals" published by the Oxford University Press.

13. Papers should be complete when submitted for publication. As alterations and additions at the proof stage cause both additional expense and delay, they should be resorted to as little as possible. In making corrections in proofs the recognized symbols which will be found in the "Standard Dictionary" should be used. Second (page) proofs will be submitted to authors who should return them promptly.

Illustrations

14. As the *format* of the journals has been standardized, the size adopted being crown quarto (about $7\frac{1}{8}$ in. $\times 9\frac{5}{8}$ in. cut), no text-figure, when printed, should exceed $4\frac{1}{2} \times 5$ inches. Figures for plates should be so planned as to fill a crown quarto plate—the maximum space available for figures being $5\frac{3}{4} \times 8$ inches exclusive of that for letterpress printing.

15. Photos or drawings for illustration should accompany the manuscript and each should bear on the reverse side the name of the paper to which it relates together with the title or legend, figure or plate number, and the size to be reproduced. When giving instructions for reduction linear measurements are understood; thus, "half-size" means reduce to half the length and breadth, not half the area. A photograph should not be rolled up, nor pinned, and should

always be packed flat. A complete list of plates and figures should always accompany the paper.

16. Line drawings should be made with clear black lines on smooth white paper, preferably Bristol board. Rough paper should be avoided. Care should be taken that all the lines are drawn firmly; scratchy or grey lines, produced by the ink being thinned down, are not permissible. Drawings should be larger than the required size. All lettering should be neatly and clearly put in, care being taken to make all lettering sufficiently large to stand reduction.

17. For half-tone work, copy should be made on glossy silver paper and of the same size or larger than the size required.

18. For three-colour work, copy may be oil-painting, water-colour, coloured photograph or coloured transparency, and larger than the size required. In preparing copy, one should use only the primary colours, in any combination, as only inks of primary colours are used in printing. Originals can be enlarged, if necessary, but this should be avoided if possible.

19. For detailed instructions regarding preparation of illustrations, it would be of advantage to refer to Mr. C. M. Hutchinson's article on "Photographic illustrations" in the *Agricultural Journal of India*, Vol. XI, Pt. 3, July 1916, and Mr. A. W. Slater's paper on "The Preparation and Reproduction of Scientific Illustrations" in the *Proceedings of the Third Entomological Meeting*, 1919, which has been reprinted as *Bulletin No. 114 of the Agricultural Research Institute, Pusa.*

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Agriculture & Live-stock in India

Vol. VIII, Part II, March 1938

EDITORIAL

BOARD OF AGRICULTURE AND ANIMAL HUSBANDRY IN INDIA

CROPS AND SOILS WING MEETING HELD AT LAHORE, DECEMBER 6TH TO 11TH 1937

THE Board of Agriculture (the annual parliament of those interested in land, crop and cattle improvement) is now in two wings—the Crops and Soils Wing and the Animal Husbandry Wing. In December 1937, the Crops and Soils Wing met in Lahore. His Excellency Sir Herbert William Emerson, G.C.I.E., K.C.S.I., C.B.E., I.C.S., Governor of the Punjab, was kind enough to open the proceedings with a helpful and stimulating address The subjects considered by the Crops and Soils Wing were as follows :—

I. A review of soil survey work in India up to date, with suggestions for the future.

II. A review of the theory and practice of manuring in India with suggestions for the future—

(*a*) with reference to farmyard manure and compost,

(*b*) with reference to green manuring, and

(*c*) with reference to manuring with artificial manures.

III. A review of work on the improvement of bullock-drawn implements, with suggestions for the future.

IV. A review of plant-breeding in India with suggestions for the future.

V. A review of the work done on water-requirements of crops with suggestions for the future.

VI. A review of work done on crop protection, with suggestions for the future with reference to protection from—

(a) wild animals,

(b) insects,

(c) fungi,

(d) parasitic flowering plants, and

(e) effects of climate.

VII. A review of the present position regarding agricultural statistics (in the sense of collection and publication of data) and forecasting, with suggestions for the future.

VIII. A review of the application of statistical theory to experimental method in India so far as agricultural investigation is concerned.

There was a departure from previous practice in that all these subjects were discussed directly in the full Board and were not referred to Sub-committees. This permitted a large number of members to take part in the discussions. Even so, for certain of the most interesting subjects the time allowed was too short. In dealing with the question of soil science, the Board had the advantage of the presence of several highly placed Irrigation Officers and also of members of the staff of the Irrigation Research Laboratory in Lahore. Alkali soils naturally came in for a good deal of attention. Soil surveys were also considered and the Board passed a resolution in which, while recognising the need for soil surveys of limited nature for special purposes and to suit local conditions, it recommended that, in addition, in all future schemes of agricultural or irrigational development, steps should be taken to adopt the genetic system of soil classification.

Under the subject of manuring, perhaps the most interesting discussion centred on the making and use of composts. In certain parts of India, compost making has become a standardised practice and in other parts there are local difficulties in its manufacture and use. There is still a very considerable amount of work to be done to determine its real manurial value. Perhaps the very simplest method of compost production was that described by the Director of Agriculture, United Provinces, which consists in piling the trash on the field where it is produced and composting it there during the rains. The review of work on bullock-drawn implements was introduced by the Research Engineer of the Madras Agricultural Department whose sixteen-page pamphlet on this subject is a valuable and outspoken document. Discussion centred for a time on the place of the inversion plough and of the indigenous plough in Indian agriculture. The value of the country plough as a dry

farming implement and a general purposes implement was stressed. The place of the iron plough, where deeper cultivation is required and where the nature of the soil and of the climate demands deeper cultivation, was also largely cleared up. The need for standardising and cheapening implements was emphasised. The relative values of rubber tyres as against ball-bearing country cart-wheels also elicited a lively discussion.

Plant-breeding in India was reviewed by the Imperial Economic Botanist, who mentioned the progress that had been made in connection with wheat, rice, cotton, sugarcane, linseed and tobacco. He suggested the need for maintaining crop collections and expressed the belief that certain problems might best be handled at one or two central stations. The Board in a resolution recommended that plant-breeders should, in the course of their work, attempt a study of genetical variability with the object of cataloguing the characters available for use in planning new crop types and building up a picture of the genetic composition of the species.

In the discussion on the water-requirements of crops a valuable summary was given of the present state of our knowledge and attention drawn to the danger of generalising from pot-cultures. The Irrigation Officers took a prominent part in this discussion. Both Irrigation and Agricultural Officers stressed the point that we should aim, so far as canal water was concerned, at studying the problem from the point of view of getting the greatest use per cusec, *i.e.* spreading a cusec of water on the largest possible area.

The review of work done on crop protection included really five subjects and suffered from lack of time for full discussion of these but the papers presented and the reviews given are of great value. The contribution by the Plant Pathologist to the Government of Bombay dealing with protection against fungi by the production of resistant races, was specially valuable.

The present position regarding agricultural statistics in the sense of collection and publication of data and forecasting was ably dealt with by the Director of Agriculture, Punjab, and the discussion on this subject was also very illuminating. It is well known that, as regards money crops, in many areas in India, the so-called standard yields no longer represent the facts. In the Punjab, for example, the actual yield of cotton per acre as obtained from the figures of the ginning and pressing factories, is very much higher than the standard yield. The following resolution was passed by the Board :—

> 'The Crops and Soils Wing desires again to emphasise the importance of adequate statistics of agricultural production as a basis for the work of the agricultural departments on the improvement of crop production. The extent to which agricultural departments are responsible for such statistics varies in different provinces and States but in all cases other departments are closely concerned. The Board however suggests for the consideration of the authorities concerned that agricultural departments should be placed in a position to make a closer study of this problem.

The Board desires that a record of the discussion be submitted to the Government of India, Provincial and State Governments and the Imperial Council of Agricultural Research for consideration '.

Statistical theory applied to experimental methods in India, so far as agricultural investigation is concerned, was introduced by Professor P. C. Mahalanobis in an admirable summary which reviewed the whole field and yet is completely comprehensible to the layman. This valuable paper is being enlarged and improved and will be published shortly in one of the Council's Journals.

The papers and proceedings of this meeting of the Crops and Soils Wing will, it is hoped, be published about the middle of the current year. Following the meetings in Lahore, most of the members proceeded to Lyallpur for a two-day visit to the College of Agriculture and its surrounding farm and gardens where the staff not only demonstrated very efficiently all the work going on at this important centre but also royally entertained the visitors. The Crops and Soils Wing meeting of 1937 will long remain in the memories of those who were fortunate enough to take part in it.

A 'Gavara' ryot

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

VIII. THE MADRAS CULTIVATOR

1. A 'GAVARA' RYOT

BY

B. RAMIAH GARU, B.Sc. (Edin.)

Deputy Director of Agriculture, First Circle, Vizagapatam

A 'Gavara' ryot is a typical cultivator of the southern parts of the Vizagapatam district in the presidency of Madras. The Anakapalli taluk may be said to be the stronghold of this community. In the municipality of Anakapalli itself, there is a part going by the name of 'Gavarapalem'. There are villages, hamlets or suburbs of villages with which the word Gavara is associated, *e.g.*, Gavaravaram, Gavarapeta and Gouripatnam. The Gavara is of an average stature, well-built, and possessing by habit a remarkable power of endurance for physical work. On account of the outdoor life the Gavaras lead during the greater part of the day, their men, women and children are generally healthy. The Gavara is a master of the art of garden cultivation, besides being a shrewd and intelligent arable farmer. Among intensive cultivators, he ranks next only to the class of gardeners who make a speciality of the growing of vegetables. Age-long experience has taught him to adjust the details of his operations in such a way that he and the other members of his family are kept engaged throughout the year and employ as little outside labour as possible. Thus, he incurs the minimum of cash expenditure and obtains the maximum of produce per unit of land. He also realises better prices for his produce by selling his garden produce in the retail market himself or through other members of his family. Few other classes of ryots can compete with him and the Gavaras as a rule are generally better off than other classes of cultivators placed in a similar environment. Being an expert in his business, he is slow to be convinced of improvements but when once convinced, he adopts the same readily and intelligently and benefits himself quickly.

Foremost among the crops in the growing of which he is an expert is sugarcane and the cultivation of this crop is so closely associated with the Gavaras that wherever one sees sugarcane growing well, one may expect the village to be inhabited by the Gavaras. In villages where other castes live, the Gavara monopolises the cultivation of this crop. The fact that the Vizagapatam district is the largest

cane-growing area in the Madras Presidency, accounting as it does for about one-third of the total area in the Presidency, is not a little due to his enterprise and keenness. He has not only spread cane cultivation far and wide in the district but also into the neighbouring districts of East and West Godavari, in some parts of which cane cultivation is of recent introduction. Cases have been traced in which the Gavaras emigrating temporarily to these districts, as casual coolies in a bad season, remained there, being attracted by the higher wages and permanent employment. Having saved some money, he becomes a tenant cultivator, introducing sugarcane and other crops and finally purchases the holding and settles down permanently.

He is fond of other crops, too, including *ragi* (*Eleusine coracana*), onions (including seed crops), root crops such as sweet potatoes, Dioscorea, elephant foot yam, Colocasia, ginger and different kinds of vegetables. Among fruit trees he has developed the cultivation of guavas around Anakapalli to a remarkable extent. He looks after his cattle well and often makes money by purchasing young calves or buffaloes, rearing them and selling them after making use of them for his own cultivation for a season or two.

Industry and economy in his profession are not his only merits. He is frugal in his domestic life, having little time to indulge in costly habits and pursuits. His food is simple and mainly consists of his own produce ; although he eats some rice and *ganti* (*Pennisetum typhoideum*) his main staple food is *ragi* (*Eleusine coracana*) which he produces on wet, dry and garden lands. The Gavara ryot being generally above want consumes more meat and fish than other cultivating classes. In some places, cotton is grown and hand-spun into yarn but the practice is, of late, going out. The woman, as already stated, also works in the field with her children as soon as they are about five or six years old. In fact, she may be said to be the maker of the Gavara's fortune, for, without her co-operation, the Gavara could not have risen to his present position as an economic and efficient cultivator. While at home, the woman attends to dairying and earns a fair income thereby.

In respect of education the Gavaras are rather backward. As the children's services are needed in the field from a very early age, few can afford to send their children to school without upsetting their domestic and farm arrangements. There are very few people in service, high or low. Of late, attempts are, however, being made to improve their education. A Gavara Association has been formed at Anakapalli and is doing considerable propaganda work to uplift the community in general.

The Gavaras are generally simple and of an upright character. They only mind their own work and do not unnecessarily interfere with others, but when they are interfered with, they are assertive and aggressive to safeguard their interests and rights. They are loath to go into litigation, and rarely fall a prey to the temptations of touts or to party feelings. Since the institution of taluk

boards which were, however, shortlived, some of the well-to-do Gavaras have begun to enter politics, a field which is new to them. They, however, spend very little of their own money on such affairs.

There is nothing particular to be said about games and amusements of the Gavaras, which are generally the same as those of other agricultural communities. Model ploughs and *piccotahs* are among the toys of young children indicating the interest taken by them in garden cultivation even from such an early age.

The Gavaras take part freely in the village festivals along with other communities and offer annual sacrifices but these of late are being discouraged. There is one festival, however, which is specially celebrated by this community, namely the Jagannaikulu festival which falls in June-July. This is suggestive of the association of this community with Oriyas at some distant date (Jagannadha Bhakta). The worship of the Brahmini bull is of the utmost importance. Every village keeps or maintains a bull which is taken in procession during Sankranti festival.

Marriage and other ceremonies are in common with those of other communities. The bride in most cases gets presents to the extent of three tolas of gold and sixty to eighty tolas of silver in the shape of ornaments, while the presents given to the bridegroom are worth about half of this. Divorce and widow remarriage are allowed in this community.

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

VIII. THE MADRAS CULTIVATOR

2. THE CEDED DISTRICTS RYOT*

BY

U. VITTAL RAO

Assistant Director of Agriculture, Bellary

IN spite of over a century of peaceful rule, the Ceded Districts ryot retains the sturdiness of his fore-fathers. This may be attributed to his continuous struggle with the forces of nature. He is simple and frank in disposition and generally peaceful, but when roused by village factions he sometimes goes to extremes. He lives in houses that are crowded together. There may or may not be a street in the village but a narrow winding path is common. Traces of old protective fortified walls and a gateway into the villages are often visible. His house is constructed of rough stone in mud, plastered with mud inside, but rarely outside. The roof is flat and is built on rafters over which a layer of straw is spread and alkaline earth is spread on the top. A circular hole is left in the roof for light and ventilation and this is covered by a pot in the rainy season to keep out the rain. The roof serves as a place for storing miscellaneous articles. Windows are usually absent. There is sometimes a narrow front verandah. The front of the house is reserved for his cattle, which usually consist of a pair of bullocks, a cow or a she-buffalo and a few sheep. The rear part of the house is elevated and consists of one or two rooms which are used for himself and his family. The only articles of furniture are two or three bamboo rope cots. His utensils are chiefly mud pots. There may or may not be a hurricane lantern. These and agricultural implements are all that are to be seen inside.

The ryot's staple food consists of millets called *jonna* (*Andropogon Sorghum*), *korra* (*Setaria italica*), *ragi* (*Eleusine coracana*), *sajja* (*Pennisetum typhoideum*) and *samai* (*Panicum miliare*). Rice is only eaten occasionally. Millets are usually pounded and cooked like rice, except *ragi*, which is ground. It is flavoured with a vegetable curry when vegetables are available but this is rare. These foods are also commonly used in making *rotti*—roasted cake. The latter is taken with a bit of chutney. The ryot's curry and chutney are highly spiced with chillies. Meat is only taken on festive occasions and it is obtained from stock on the

*At the end of the Third Mysore War, the Nizam by treaty was in possession of the country now covered by the districts of Bellary, Anantapur, Kurnool and Cuddapah. Owing, however, to the unsettled state of his territories a subsidiary British force was stationed in the Nizam's Dominions in exchange for which four districts were handed over to the British. These four districts of Bellary, Anantapur, Kurnool and Cuddapah are still known as the Ceded Districts.

The Ceded Districts ryot

farm. The ryot usually takes three meals a day—one in the early morning before he starts work, one during mid-day and the third at dusk. He usually finishes this off with a cup of water or buttermilk. He is very fond of his *beedi* (Indian cigarette) and chews tobacco occasionally. His womenfolk are fond of chewing betel leaf. Though not generally addicted to the consumption of alcohol, he likes a drink if it comes his way.

Owing to scarcity of water he cannot take a bath more often than once a week and this he usually does on a *shandy* (market) day. His chief source of water is the pond wherein rain water collects. Most of this is used for drinking purposes till it becomes muddy. Wells are few and far between and it is not unusual for him and his folk to walk miles for water. Mainly owing to scarcity of water and its contamination, the Ceded Districts ryot suffers a good deal from Guinea worm.

The chief articles of clothing are the *dhoti* and a large white turban. A shirt is common now-a-days. A pair of thick-soled sandals and a stick complete his dress. During winter he will carry a locally-woven woollen *kumbli* or shawl. His womenfolk dress in a *sari* and a tight-fitting jacket. The end of the *sari* is often turned over the head. The favourite colours are black or brown with red or yellow mixtures.

He does not indulge in any special games. He is fond, however, of *uppuata*, a game played with stones on a design. He is fond of stories from the Ramayana and the Mahabharatha, especially when depicted in drama. He has been known to yoke his cart and to travel ten to fifteen miles to see such shows. At night Rama *bhajan*, *i.e.* the singing of devotional songs and dances, by the light of an oil lamp, is common in many villages. His children take part in *kolattam*, hide-and-seek, marbles and similar games. The game of *kolattam* is played by twelve girls forming themselves into two circles, each consisting of six. The outer circle remains stationary while the inner circle moves in a clockwise direction. While thus in motion each girl from the outer circle exchanges places with one in the inner circle and when completed the players again return to their original places. A *jada* is thus formed. In order to undo the *jada* the inner circle moves in an *anti*-clockwise direction and the girls exchange the places as before, but in the reverse order.

Hindu by religion he reverences the orthodox gods in a general way. But Hanuman is his favourite God to whom he pays real worship and homage. Hanuman shrines are common in all villages. Desire for the worship of village deities is also strong in him, Mariamma and Durgamma being the chief of them and to whom he offers animal sacrifices. Trees such as Ficus (*Ficus relegiosa*), *margosa* (*Melia indica*) and *vanni* (*Prosopis Spicigera*) and snake stones are also occasionally worshipped. Visits to distant shrines are common and chiefly for the purpose of protection against sickness.

Telugu is his mother tongue and he also understands Hindustani to some extent. He shows little aptitude for the three R's and the tract is the most backward in the presidency in the matter of literacy.

Nature has endowed him with by no means the best of conditions for agriculture. The rainfall is light and often fails. His soil, if it is black, is rich, but it has seldom been called upon to do its best; if red, it is often poor and infested by weeds. His holdings are large, scattered and sometimes far away from the village. The number of his cattle is small and is limited to the fodder that he can grow. Agriculture under these conditions requires perhaps good fortune more than skill and knowledge. However, he understands the husbandry of the soil and he is skilled in making the maximum use of a scanty rainfall. The genius of the Ceded Districts ryot is seen in the implements that he uses. In point of simplicity, efficiency and cheapness they are probably not equalled anywhere in the world.

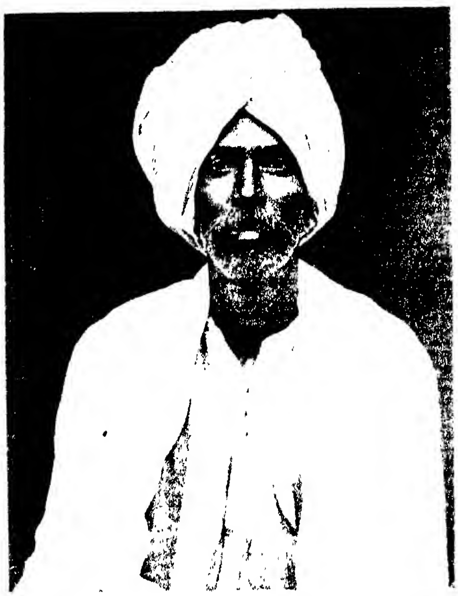
Except the harvest, all agricultural operations are done with implements and bullock-power. His skill in handling implements and cattle is unrivalled. He can sow crops in lines with great skill. His rich agricultural experience is embodied in numerous proverbs, and the following are a few typical ones, though the force of the original is lost in the translation :—

"Wait till *Uttara* : if there be no rain in that period, prepare yourself to start, and if there be no rain even in *Visaka*, quit your house."

"The season for sowing closes with *Arudra*."

"A field without a tree is like a village without relatives".

In such adverse climatic conditions, it is not to be wondered at that the Ceded Districts ryot is poor, for scarcity years follow one another at short intervals. At the worst, his borrowings may result in his becoming a landless labourer. Nevertheless he lives and works on, though it needs a stout heart to do so. The Ceded Districts ryot is possessed of one.



A Kistna Delta ryot

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

VIII. THE MADRAS CULTIVATOR

3. THE KISTNA DELTA RYOT

BY

T. BUDHAVIDHEYA RAO NAIDU GARU

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THE Delta ryot is generally frugal in dress and habits, with a cloth tied to the waist up to his knees and another wrapped round his head. He is generally quiet and rather slow in movement, going about with a long bamboo stick in his hand. He generally goes out with an umbrella for inspecting the fields. He is by nature easy-going but exerts himself sufficiently during the planting and harvesting seasons. In the off-season he has little to do. His wants are few—he has two full meals a day besides breakfast which consists of cold rice and buttermilk with green chilli or onion or a chutney. Rice, of course, is his staple food, with soup or curry and his meals always end with buttermilk and rice. He bathes daily and uses a few clothes but gets them washed daily. He spends some time in playing cards during the day and takes delight in smoking and in hearing a Puranic story read by a friend. He is not averse to getting into the civil courts or quarrelling in the distribution of water to fields.

As the soils in the delta areas are mostly clayey and moist, he keeps small or average animals but they are not generally in very good condition. Generally a pair of work-animals is maintained for about ten acres under cultivation besides two she-buffaloes for milk and a double-bullock cart for transport of the produce from the fields. He is an expert at levelling, trimming bunds and winnowing grain. He sometimes engages himself in making ropes for cattle and other purposes during the day. Early to bed and early to rise is his motto and he starts work particularly early during the harvest season. During winter he covers himself with a big thick sheet of cloth folded double and which passes over his head. The Delta ryot generally lives in a tiled house, unless his holding is small and he is poor. With the increase of population the size of his holding now-a-days is getting smaller, so much so that the average holding may be anything between two and eight acres. When paddy was fetching a high price the Delta ryot was rather proud of his holding. At that time most of the ryots contracted debts and spent much on marriages, etc., but with the fall in price of grain and consequently of land, they have now become debtors. There is, however, a change in his attitude. He is now trying to produce more and reduce his expenditure ; it will take time, however, before he is well-off again.

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

IX. THE ORIYA CULTIVATOR

BY

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THE physical aspect of Orissa varies from the hilly and forest-clad tracts in the interior, having conditions more or less similar to those prevailing in the Chota-Nagpur Division of Bihar, to the flat alluvial tract along the coast, cut up by several large rivers and their innumerable branches which form a network of water ways and finally find their outlets into the Bay of Bengal. The hilly and backward tracts of the country in the interior are still the homes of aboriginal peoples like Khonds and Sawars who are yet in an early stage of development, with primitive methods of agriculture, the forked branch of a tree being in many places their only agricultural implement. Compared with them, the peoples of the coastal plains are advanced with a highly-developed civilization and culture, several centuries old, behind them.

The tiller of the soil in the coastal districts is generally regarded as the typical Oriya cultivator. The incidence of malaria and other diseases and defective nutrition makes him by no means strong, but he has a fair intelligence, the heritage of his old civilization and culture. He is sometimes maligned for lazy habits and lack of enterprise. but his life is a long struggle with natural forces such as storms, floods and drought, to which his province is specially subject on account of the geographical position This is not conducive to the development of a desire for fuller living. The same man, in more congenial surroundings, is a different being, with industrious and active habits comparing favourably with his brothers of the neighbouring provinces.

His habits are simple and his requirements are but few. Two *dhoties* and two *gamchas* (a piece of cloth used both as towel and as a covering for the upper part of the body), of local manufacture, are all that an average Oriya cultivator requires by way of dress for the whole year. His main meal consists of cooked rice in the evening, served hot after his day's work, with what little vegetables his womenfolk may gather from the little garden in his backyard. The unconsumed portion of the rice is carefully left over soaked in water (known as *pakhala*) and this he eats in the morning before he goes out for his day's work. With this if he has his favourite dried fish (*sukhua*) occasionally, he is supremely happy.

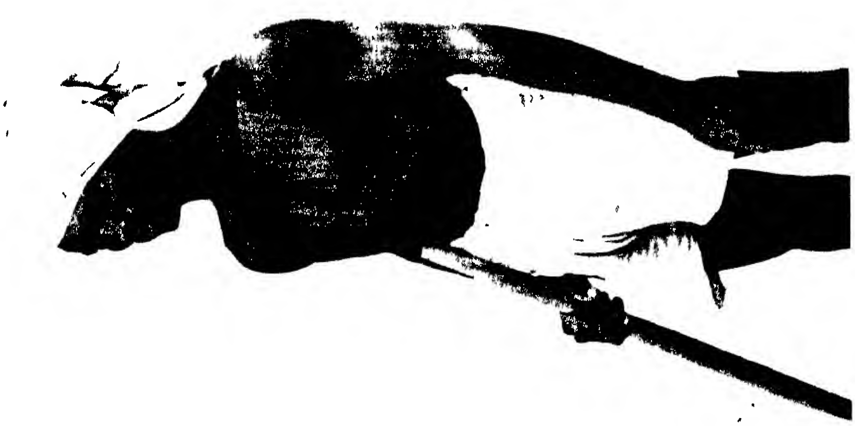

FIG. 1 An Oriya cultivator

FIG. 2 An Oriya cultivator at work

He must, however, have his *pan* (betel leaf) with *gunda* (tobacco) at any cost. Such frugal fare does not cost an average family of five members, including children, more than Rs. 5 to 8 per month. The small cultivator generally supplements his ordinary means of livelihood by working as a day-labourer on his neighbour's land, for which he is generally paid in kind. His savings in the best of years are but slender, as rice is practically his only crop, which leaves very little margin of profit in days of depression. His uncertain crop and slender savings bring him to the doors of the money-lender charging exorbitant rates of interest. The part clearance of his debt, in a year of good harvest, leaves him but little balance to store against and carry him through the days of need that may follow his next harvest. He is kind by nature, good-humoured and religious-minded and if the brotherhood of man is evident anywhere in India, in these days, it is in Orissa. Every village used to have its " Bhagabat Ghar ", a sort of common-room where sacred religious books are kept and read out at night by the elders to the villagers, maintained by contributions from the villagers. But now, for various reasons, these are gradually falling into disuse

An average Oriya cultivator, having a family of about five members including children and owning about two to three acres of land, has a pair of bullocks, which he hires or lends out to his neighbour, when not required for his own land, and for which he receives back in payment the services of his neighbour's bullocks when he needs them. He does not consider it necessary to make any provision for his live-stock which have to eke out their existence as best as they can, by grazing on the over-grazed *ails* or fallow lands in the village, for which reason the cattle population of Orissa is proverbially poor. The dung is generally used for fuel purposes, especially in the flooded tracts, where there is great dearth of fire-wood and hardly one-fourth of the total quantity goes back to the land. Village sweepings, ashes, etc., dumped in heaps (*khata*) are generally used as manure but the quantity is so small that a plot of land has to await its turn for receiving the same. The flood that visits his land periodically or regularly (as in the habitually flooded areas) is to him a blessing in disguise in so far as the land is concerned, as it brings down with it enormous quantities of silt from the upper reaches of the rivers and spreads it on the soil, adding to its fertility.

An Oriya cultivator must sow his rice at any cost, though he knows that his crop is uncertain. Left to his own resources and without any guide from outside to lead him on the way of his material improvement, he will remain where he stands on account of his lack of initiative and enterprise but it must be said to his credit that, by virtue of his simple and trusting nature, he is quick in his response to the efforts made by his well-wishers for his economic uplift. The Department of Agriculture has stepped in as his sympathetic adviser and guide and by its activities for the introduction of improved crops, manures and methods among them, by demonstrating them free on their lands, has been his friend in need. It is

gratifying to note that his response to this help has been remarkable. A flood-resisting variety of sugarcane, for instance, was introduced, a few years back, into a habitually flooded tract where sugarcane had never been known before, for the partial replacement of the uncertain paddy crop. Its success as a remunerative crop suitable for the flooded tracts at once appealed to the ryots and within the last few years it has established itself as a common crop along the coastal belt of Orissa. Similarly, the Oriya cultivator has nearly completely discarded his old *deshi* varieties of sugarcane and adopted the Coimbatore variety No. 213, of which the present acreage is about three times as much as the total cane area ten years back. He is gradually taking up the varieties of improved rice found suitable for the country in preference to his old low-yielding varieties. The area under the improved rices has gone up to 18,061 acres within the last few years. The most remarkable progress has been made by him in growing vegetables. About fifteen years ago every bit of green vegetable consumed in the country used to be imported from outside. But now, as a result of the free demonstrations made by the Department, the Oriya cultivator is so convinced of the suitability of vegetables to his land and climatic conditions and their economic value that vegetable growing has become popular even in the interior of the country and Orissa may now be said to be fairly independent of outside supply.

ANIMAL DISEASES IN RELATION TO THE ECONOMY OF MAN AND INDIA *

BY

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"For that which befalleth the sons of men befalleth beasts; even one thing befalleth them: as the one dieth, so dieth the other; yea, they have all one breath....".

Solomon (970-933 B.C.).

THE EVOLUTION OF THE CONCEPTION OF DISEASE

The significance and truth of these philosophical words of generalisation regarding life and death of man and his animals could scarcely have been appreciated in the days of Solomon the wise. Science as we know it to-day did not exist, but it is obvious that the instinct of self-preservation and the longing to relieve suffering in fellowmen had been there, and that the intriguing problem of disease (pain, suffering) causation had started to engross the human intellect. The pestilential calamities that befell men were sufficiently dreadful, and their animal possessions, providing several essential services, were being swept away equally ruthlessly. Diseases of man and animals alike thus came to be looked upon as supernatural visitations, meted out as punishment by invisible gods, demons or spirits of the dead, or as even caused by the 'evil eye'. Invocation of the benign, and the propitiation of the malign influences with the aid of amulets, charms, incantations and sacrifices were practi ed as remedial measures. These notions were not by any means characteristic of any one country.

Then came the Father of Greek Medicine, Hippocrates, born about 460 B.C. He deserv s credit for recognising for the first time that diseases are only processes of Nature, and that there is nothing divine or supernatural in them. He declared that the body of man in health contains four fluids or humours, blood, phlegm, yellow bile and black bile, in proper proportion and mixture; sickness is produced when one of these fluids is either increased or decreased and is no longer properly mingled with the other. Nearly two thousand years later Paracelsus urged an impartial observation of Nature as the fountain of knowledge, in place of blind belief, and with the appreciation by Morgagni of what organic alterations in the

*This is the eighth of a series of popular articles for practical farmers on various animal husbandry subjects of general interest.

structure of the body (lesions) co-existed most frequently with changes in the bodily functions (symptoms) under the general law of cause and effect, scientific medicine was born. Bichat made the discovery that organs consisted of general and special tissues, and that corresponding to these, diseases produced general and special tissue changes, and this was the inception of pathological histology (systematic study of the minute structural or morphological elements characterising each disease).

The greatest advance of this early period was, however, yet to be made by Virchow by demonstrating the full significance and the mechanism of cell activity. He showed that there is no essential difference in the laws that govern health and disease. Physiological (health) and pathological (disease) processes differ only in relation to stimuli to cells, for abnormal stimuli lead to exaggerated responses and more lasting disturbances in cell-life. He showed that pathological lesions are therefore only gross anatomical (structural) expressions of disproportions in the relative values of stimuli and cell reactions. This contribution on cellular pathology gave the right direction to the concept of disease in its progressive evolution through the ages, and in addition has had the important bearings upon all biological sciences of to-day.

In this manner, was medicine of man and animals, born almost contemporaneously of the common parentage of credulity and empiricism, and nurtured together with the milk of rationalism through the difficult years of early childhood, full of trials and errors. In surveying the progress of the healing science through the later stages of youth and adult-hood, one observes the pioneers approaching the problem of disease of the human race or animal species as a single study.

The early and subsequent knowledge of anatomy, physiology and disease processes of man was largely obtained with the aid of studies upon animals, and in this connection it is of interest to note that the earliest anatomical model known is a clay model of a sheep's liver in Babylonia dated 2,000 B.C., and the earliest recorded surgical operation is the trephining (perforating the skull) of sheep for staggers. With the commencement of specialisation in individual branches this broad perspective was lost for a time and the human physicians suffered unmistakably from the depressing influence of isolation. Any pioneering work, whether on microscopy by Leeuwenhoek, or that on bacteriology and immunology by Pasteur, or Lister's work on antisepsis, or similar advances, being applicable equally to man and animals, established the essential unity of medicine. Principles of general pathology thus emerged, providing a clear insight into the complex mechanism by which predisposing factors and exciting causes of disease interfered with the normal structure and function of living tissues (disease), and as to how factors founded in the organisation of an individual reacted to external organised agents, whether animal or vegetable parasites. An organism which derives its nourishment from the tissues of its host is a parasite, and different

classes of disease agents, bacteria, fungi, protozoa (smallest and single-celled animals) and arthropods (members of the animal kingdom with segmented body and jointed limbs) are illustrated in Plate XI. All bacteria, fungi or insects are not harmful, and it is remarkable that some of them affect particular animal species only to the exclusion of others, *e.g.* anthrax resistance possessed by poultry, glanders in equines but not in cattle, and rinderpest in cattle but not in horses. Regarding arthropods, some can set up disease by themselves (Plate XI, figs. 21-23), others act either as mechanical transmitters of parasites or may even provide favourable ground for the cyclical development of the parasite concerned (Plate XI, figs. 19 and 20). While the above-mentioned disease agents can be seen under the microscope, there is yet another important group—viruses— which are capable of setting up disease in healthy animals without being visible under the highest powers of the microscope. Their exact nature is not yet clearly known but the largest of the viruses have been seen in microphotographic preparations. The work on animal viruses has thrown considerable light on some of the baffling problems of this group. In the study of cancer, transmissible growths of animals have opened up a new line of approach, and the current hypothesis that the so-called gin-drinker's liver (cirrhotic) of man was the result of alcoholism receives no support from the finding in old animals of similarly affected livers. Against Robert Koch's memorable work on anthrax, common to man and animals, did not only reveal for the first time, a specific microbe as the cause of a disease, but what is more important, certain general principles of wide applicability as a new method of approach for ascertaining if any suspected micro-organism is the cause of a disease, emerged, and are now known as Koch's postulates. These postulates require the constant finding of the microbe in diseased tissue, its isolation in pure culture therefrom, production of the disease artificially in healthy animals with the culture and then recovery of the organism from the experimentally infected animals.

The above remarks have been made to illustrate how, with the elaboration of a new method of research, or with the acquisition of any new knowledge, our everyday armoury against the numerous harbingers of destruction (pathogens), whether affecting man or animals, has been equally strengthened. To take one or two instances, one remembers how nutritional diseases of animals (Plate XII, figs. 12 and 13, rickets in a dog and osteoporosis in a horse) have been studied by Mellanby and others to solve the problem of similar diseases in man. Again in the comparatively new branch protozoology, the demonstration by workers in the veterinary field that certain infectious diseases can be carried from animal to man only through certain insects acting as intermediary agents (Plate XI, figs. 19 and 20) has had even more far-reaching effect in the elucidation and control of some of the most dreaded of human scourges like sleeping sickness, malaria or yellow fever. The specific instances referred to are: Theobald Smith and

Kilborne in 1893 showed that Texas fever of cattle was a tick-transmitted piroplasmosis, and Bruce showed the transmissibility of trypanosomiasis of domestic stock through Glossina flies, while Ronald Ross's discovery of the transmission of bird malaria through Culex mosquitoes led to the discovery of the role of anopheline mosquitoes in human malaria. Did not the celebrated biologist John Hunter say that in the course of a variety of experiments on animals and vegetables he had frequently observed that the results of experiments in the one explained the economy of the other and pointed out some principle common to both ? It appears that the demonstration of the nature of the virus causing mosaic disease of tobacco plants as a crystalline protein has already led to the finding of at least one animal virus, that relating to Shope rabbit papilloma to be a heavy protein, and it is not unlikely that the precise nature of the viruses of animal and human diseases will be revealed along the line indicated by plant pathology. Disease processes in man and animals have thus been mutually elucidative by throwing cross lights and analogies, and difficulties and obstacles in the understanding of the conditions, which previously appeared to be insuperable, have repeatedly been surmounted with the aid of the comparative method of studies, thanks to the work of Theobald Smith, Manson and Osler in this connection.

Importance of animal diseases

In the days of the primitive herds-man and since, animals have been reared and maintained primarily from the utilitarian aspect. Animals have provided meat and milk for human sustenance, clothing for protection, and motive power for tilling land and transporting produce, besides supplying fertilisers and even therapeutic agents. (In China and Egypt organotherapy was practised in ancient times). With the progress of time and civilisation, this utilitarian aspect has extended enormously, and one finds that animals or animal products are being put to many new uses in commerce and industry. Like other aspects of animal husbandry the study of animal diseases has therefore come to occupy the status of a major problem of human welfare. To recount the reasons briefly :—

(*a*) The mutually interdependent relationship that medicine of the lower creation bears to that of the human species, and the extent to which animal experiments and the analogies provided by animal disease have influenced the progress of human medicine in the past have been already mentioned. Of equally far reaching importance has been the elaboration from animals of more and more of biological products of advanced efficiency for the relief of myriad human ills, *e.g.* calf lymph vaccine against small pox, horse serum for diphtheria, tetanus streptococcal infection and haemorrhage, rabbits and sheep brain vaccine for hydrophobia, etc. Further, such valuable gland products of animals as pepsin, insulin, adrenalin, pituitarin and prolan are of constant use in human therapeutics. Besides, the standardisation of the doses and potency of the preventive sera and vaccines has also been achieved by animal tests. A novel method of controlling

the serious blood-fluke disease of man in the Far East and Egypt (schistosomiasis) has been by the rearing of ducks and geese.

(*b*) Animal husbandry by itself, and along with arable agriculture, has served as the means of livelihood to an increasing number of people, or as a healthy diversion to many. It requires to be protected from the danger and loss attendant upon the onset of animal diseases, as otherwise the whole structure of agriculture is undermined. Further exact information is available to show that with modern methods of feeding, hygiene and general herd management, not only can a reduction in the incidence of animal diseases be achieved, but a shaky agriculture can be made to see prosperity.

The exact monetary value of losses inflicted at present by animal diseases on agriculture and animal industry has not been calculated recently. In Plate XII, illustrations of some chronic diseases of animals of this country have been given, and epizootic diseases like rinderpest, haemorrhagic septicaemia, blackquarter, etc., are still taking heavy toll. The cattle population has increased, and the prices of live-stock have gone up considerably since 1892 when Burke made the statement: "It has been estimated after the most careful investigation, that the annual money loss to India alone from preventible contagious disease among agricultural animals, cannot be less than £6,000,000 sterling". As a concrete instance—it may be mentioned that as a result of one disease alone—the Warble fly infection, the depreciation in the value of hides in this country has been estimated to be 1·5 crores of rupees annually. These figures indicate the magnitude of the problem of animal diseases in this poor country Nor is this the total extent of the loss

At one time, India used to enjoy a substantially large export trade in live-stock. Year after year this trade dwindles since the importing countries, one after another, have refused to run the risk of re-introducing diseases, which they have already eradicated from their respective countries, while the epizootic diseases continue within the Indian continent. The loss sustained by India may be appreciated from the figures of two successive years, for instance, the return from export trade in live-stock and live-stock products in 1933-34 was 32·3 crores of rupees, while in the following year the figure was only 12·9 crores. In considering these figures, one must remember this rapid and large fall in live-stock export has taken place notwithstanding the fact that Indian cattle have been found to be very suitable for rearing in different parts of the world, *viz.* Zebu cattle in Australia and British Guiana, Krishna Valley cattle in Dar-es-Salaam, and Indian buffaloes in Tanganyika. Further a well-known expert who has surveyed the subject of animal breeding in the British Empire, has rightly pointed out the prospect before India. To quote his own words: "If animal breeding in the tropical Empire followed a more closely unified policy and there were greater contacts between India and the Colonies, it should be possible for India to be the stud farm of the

Tropics". In order that India may avail of the large and potential overseas market that awaits her, as a means of regaining the economic prosperity of her people, she must put her own house in order, and no longer lag behind the world developments pertaining to the campaign against animal plagues. In a country like ours, which maintains the largest live-stock population in the world, and where the annual cash value of live-stock and products has been estimated at 2,000 crores of rupees, the necessity of concentrated attention being devoted to live-stock diseases is obvious.

(c) Besides forming the wealth of the nation, animals are to a great extent connected with the health of the community. How profoundly the progress of medical research has been influenced by the study of animals and their disease has been surveyed already. It remains now to emphasise that the bearing of animals as reservoirs of infection for man, and the transmissibility of animal disease to man either directly or by handling or consuming animal foods have presented a public health problem of no mean magnitude. The part that live-stock play in determining the health of the people may be considered in two parts: (*i*) nutrition and (*ii*) disease.

Firstly, foodstuffs of animal origin are indispensable for the maintenance of health and physical development of men, for foods of plant origin do not supply proteins of such high nutritive value. In India, milk, ghee and other dairy products have even a greater importance as essential constituents of a complete dietary, than in other countries, particularly as a considerable proportion of Indians are non-meat-eaters and live on an exclusively vegetarian diet. Moreover, milk contains growth-promoting factors and accessory principles, like vitamins and mineral salts, which consolidate the resistive powers of the bodily system against diseases. The importance of milk as an essential food, producing an all-round well-being of man, is being increasingly realised all over the world, and concerted action is being taken to increase the average consumption of milk *per capita* by various methods, including the lowering of the price of the commodity in relation to the purchasing power of individuals. It may be noted here that one of the main findings of the Advisory Committee on Nutrition in the British Isles runs thus: "From the health standpoint there is no other single measure which would do more to improve the health, development and resistance to disease of the rising generation than a largely increased consumption of safe milk by mothers, children and adolescents." Similarly meat and eggs form a very important part of the human dietary, as they are comparatively easily digestible, and supply in small bulk considerable amounts of nutritive and body-building materials, being particularly beneficial to invalids and convalescents. The necessity of foodstuffs of animal origin as a means of securing and ensuring human health is obvious, and the production of safe animal food is quite within human power.

Turning to the other aspect of public health, *viz.* that relating to animal diseases communicable to man, one finds frequent reports of the occurrence of outbreaks among human beings, in some of which very drastic results followed. Evidence exists of several cases, where the peculiar and novel features of animal diseases as exhibited in human beings could not be appreciated till collaboration or helpful suggestion of the veterinarian dealing with the disease entity as affecting his animals came forth.

Diseases communicable to man

Of the many communicable diseases whose only source is one or other species of animal, the most important would appear to be glanders, anthrax, rabies, foot-and-mouth disease and certain forms of tuberculosis. This statement is tantamount to saying that if these diseases could be eradicated completely from the live-stock, the infection in human beings would automatically cease, and mankind would be relieved from the ravages of so many terrifying maladies. Again there are a number of diseases, the causative parasites of which require an animal host in order to complete their life-cycle before becoming infective to man. For example, *Echinococcus*, *Trichina spiralis* of the pig, the parasites of measly beef and measly pork (*Cysticercus cellulosae*, the larval stage of *Taenia solium*, and *Cysticercus bovis*, the larval stage of *Taenia saginata* of man). In these parasitic diseases as well, control of the disease in animals will necessarily produce the disappearance of the human conditions. A somewhat comprehensive list of disease of animals and man transmissible by direct contact with animals or through the agency of animal foods has been given below for reference. It will not be necessary for the purpose of the article to consider more than briefly some of the typical diseases from the list.

Rabies.—As one of the most dreadful scourges of man, and as one which necessitates the maintenance of several Pasteur institutes and anti-rabic treatment centres, thereby causing a heavy drain on the Indian Exchequer, rabies stands pre-eminent. If the treatment of hydrophobia, as the human affection is called, be not undertaken early, and the symptoms have had time to develop, a most painful death is the invariable result. The disease has been known for over 2,000 years, and its transmissibility to man and animals through the bite of a rabid dog has been recognised since the days of Aristotle (322 B.C.), but appropriate measures for the eradication of the disease have unfortunately not been adopted in many countries including our own. That the disease can be completely eradicated by stringent quarantine measures against newly imported dogs, together with muzzling order and the destruction of stray dogs, has been amply demonstrated by certain progressive countries, where adequate vigilance over this disease has been maintained.

The disease is caused by a virus, which is discharged in all the natural excretions from a rabid animal. The fact that the virus is present in the saliva at least

a fortnight before the development of any symptoms makes the disease highly dangerous. The topographical peculiarities of the Indian continent, notably the absence of natural barriers between one province and another, provide a particularly favourable field for the spread of the disease. The Pasteur method of anti-rabic vaccination stands out as one of the monuments of research, and has minimised substantially the rate of mortality from this disease. If appropriate measures for the suppression of the disease in dogs, the natural reservoirs, are systematically adopted, humanity will be saved from the risks of one of the most excruciating forms of death, and it is of paramount importance that a wide recognition of the well-known facts in this connection is brought about.

Glanders.—An equally malignant disease but of a slower course is glanders. Though mainly of equines, it is communicable to man by the discharge from the nose, eyes and skin of the diseased horses and mules. The causative organism is a bacillus (rod-shaped bacteria) with rounded ends, which finds its way into susceptible hosts through some trifling scratch or abrasion, or as generally happens, through the oral route. Notwithstanding all the scientific advancements of to-day, this is one of those diseases for which no satisfactory palliative or curative drugs have been evolved. As far as India is concerned, one may mention here that the life of one of the most promising research workers of this country—Shilston's—was nipped in the bud as a result of glanders contracted at Mukteswar, and that another worker manifested great presence of mind and fortitude in maintaining complete records of the disease in himself.

Efficient methods for the diagnosis of the disease exist. Certain countries have already got rid of the disease, and those countries where requisite measures for its eradication have not been adopted, are standing menaces not only to themselves but to others.

Anthrax.—This disease has a world-wide distribution and affects animals of all species, but the chief sufferers appear to be cattle and sheep. The causative organism is one of the largest bacillus known, and although it had been seen earlier the pathogenic significance of the organism was established by Robert Koch in 1876. When in the blood, several organisms are found attached to each other end to end (Plate XI, fig. 4). A very well-marked capsule characterises the organism, and this fact is of value in making rapid diagnosis with blood smears made soon after death. Since the anthrax bacilli rapidly multiply in the blood-stream, and are readily disseminated throughout the body, a rapidly fatal septicaemic (blood poisoning) condition is produced, and the affected animals often do not develop any symptoms before their sudden death.

The affection is primarily one of animals but human beings are affected directly or indirectly from infective materials of animal origin. The fact that the anthrax organism readily assumes the most resistant sporulating forms, whenever it has access to a free supply of oxygen, makes the control of the disease a difficult matter. Since the carcasses may be opened without the least suspicion of the

disease being present and because blood or discharges from diseased animals may be spilt, spreading the infective principle to such places as may not readily attract notice, the difficulty of control is further accentuated. If the carcass be not allowed to be opened and is suitably disposed of, the sporulation of the bacilli is obviated. The bacilli can multiply in the surface soil, and the infection generally spreads from animal products such as hides and wool, or even from feeding stuffs containing anthrax spores. Anthrax may also be carried in the drinking water, and if diseased carcasses are not incinerated, or buried deep enough, the bacterial spores may be brought to surface soil by earth-worms. It is believed that occasionally biting flies also transmit the disease, for an authority has found the infective spores present in the flies for about twenty days.

In man the disease usually takes a cutaneous form, and one or more carbuncles (malignant pustule) may develop on the head, neck or upper extremities. When the dried spores are inhaled with impure air, the lungs are affected and what is called " Wool-sorter's disease " is produced. Through the ingestion of improperly cooked meat an intestinal form of the disease may also be set up. The disease is largely an occupational malady, being contracted by people engaged in industrial concerns dealing with hair, wool or leather, but anthrax contracted from shaving brushes has also repeatedly occurred.

From the above remarks it will be clear that the human affection can be prevented and controlled by arranging to eradicate the condition in animals. By complete disinfection of animal products used in industry, and by timely use of preventive antisera and vaccines, the disease can be controlled.

Foot-and-mouth disease.—As the name indicates this disease is characterised by the occurrence of foot and mouth lesions, not necessarily in the same animal and simultaneously. Eruptive blisters arise on the mucous membrane of the mouth, and at the junction of the skin and digits in cloven-footed animals. Most animals are susceptible, including guinea pigs, and human beings are also affected. The cause of the disease is a virus capable of passing through fine clay filters, which would hold back all ordinary bacteria. The virus of this disease has the distinction of being the first one among human and animal viruses, to be shown to be filtrable. This would appear to be one of the most contagious of animal diseases, and may be carried by infected litter, human clothes or water. The disease is enzootic (prevalent or regularly found) in India, and although the mortality may not be high, the affected animals are rendered unproductive for long periods. Infection by direct contact with infected animals also takes place.

In man, the disease is usually caused by the ingestion of infected milk products, and though mortality is rare in adults, drastic results in children have been seen, fever and vesicular eruptions in the mouth, and even an intestinal catarrh may be produced. The disease may be eradicated by the wholesale destruction of infected and in-contact animals, but it is such an expensive procedure that few countries can undertake to do so.

Pasteurisation of milk is an effective safeguard against the human infection, but for those who come in contact with infected animals particular attention to personal hygiene should certainly be paid.

Tuberculosis.—This specific contagious disease of man, animals and birds has been known to the Hindus of the Veda in the 15th century B.C. and also to the Parsees of the same time.* The disease receives its name from the word tubercle, meaning a nodule, and is caused by a highly resistant rod-shaped germ. In ordinary parlance, the human disease is called consumption, and when the lungs are affected, phthisis. That human beings can contract the disease by eating diseased meat has been recognised since the promulgation of the Mosaic Law. With the congregation of human beings into social groups, and the crowding of animals, in cities and zoological gardens, the incidence of the disease has largely increased as one of the penalties of civilisation.

The transmissibility of the disease, and its essential unity as affecting man and the lower creation was established by the celebrated Frenchman Villemin in 1865. That rabbits inoculated with material from diseased cattle developed a more rapid and severe infection than when subjected to infective materials from human cases was a very noteworthy observation made by him. Seventeen years later, the specific bacilli (Plate XI, fig. 7) of the disease were recovered by the great German, Robert Koch. Later workers discovered some differential features in the strains of the organism responsible for the human, bovine and avian disease. It is possible by a study of these features and from other facts which have emerged since, to determine whether the infection in an individual has originated from either one source or other. The disease is widely spread to-day all over the world, and as far as men and animals in this country are concerned, the disease exists not only in cities and towns but has reached the interior as well. The public health problem connected with the disease has consequently become an enormous one, and sanatoria for tuberculous patients have become a vital necessity. Preventive measures of this kind have not so generally been adopted in this country, though the urgency of intensifying combative measures against tuberculosis to meet the requirements of the situation has been repeatedly urged by both medical and veterinary workers in this country.

Regarding the veterinary aspect in India, numerous cases of the disease have now been detected among animals of all species, and the organisms isolated from the natural bovine lesions have been found to be as virulent as those in other countries. Further evidence exists to show that after the introduction of infection in crowded dairy farms a high incidence of clinical tuberculosis may develop. The usual mode of life of the stock in this country, which is largely in the open air, accounts for the relatively low incidence of the disease so far. Recent statistics have,

*Since this article went to press Krishnaswami Iyer has produced extracts from the ancient Hindu treatise *Hastyayurveda* or elephantology dating back to the period of the *Ramayana* epic, relating to tuberculosis in elephants, (*Agric. and Livestock in Ind.* **7**, 722723).

however, revealed as many as 21·3 per cent cows, 23·6 per cent buffaloes, and 31·6 per cent bullocks as affected with gross lesions. These statistics probably do not apply throughout the country, but the record of a number of definite cases of tuberculosis of the udder in milch animals including buffaloes and cows, and the demonstration of the occurrence of the specific bacilli in milk are sufficient to indicate the risk of infection to man from milk, that already exists. In a few human cases the disease has been traced to bovine infection, and it appears that one of the probable reasons why human cases of bovine origin are not more frequent is due to the practice of milk being thoroughly boiled before drinking.

A few cases of naturally acquired tuberculosis in cows caused by the human strain of the bacillus have also been recorded. The diagnosis of the disease presents no difficulty in advanced stages, and in the pre-clinical stages the use of the tuberculin test is of value. A general tuberculin testing of all cattle in selected farms should be carried out at regular intervals, followed by the elimination of reactors The isolation of reactors and building up and maintaining of herds free from tuberculosis has been successfully tried in some countries, notably Denmark, and the same will have to be carried out in this country, where slaughter of cattle cannot generally be recommended. Promising results with methods of preventive vaccination have been obtained abroad but this work still remains to be undertaken here.

In view of the existing experience that when this disease is introduced into an area, which had previously been altogether free from it, the disease spreads rapidly and assumes a very severe form, it needs to be emphasised that parts of India are still relatively free from the disease, and if untold misery and death are to be prevented, more than ordinary attention deserves to be paid to anti-tuberculosis measures in India, which forms a somewhat virgin field for the disease.

Cow-pox.—Pocks or Variola are a group of eruptive fevers affecting different animals and are caused by viruses. Cow-pox and small pox of man appear to be closely related as they are transmissible to man and bovines respectively. Contrary to the other animal diseases communicable to man, which are invariably detrimental, the transmissibility of cow-pox (*Variola vaccinia* so-called) to man has been a great boon in alleviating human suffering and in preventing death from small pox The occurrence of small pox in man dates from antiquity, and a rough and ready method of preventive vaccination (the word vaccination has originated from *Variola vaccinia*, meaning cow-pox) though somewhat risky was practised by the Chinese as early as the third century B.C., and the method appears to have originated in India even earlier. Experience existed among milk-maids that if they passed through an attack of the mild cow-pox contracted during milking the udders of affected cows, they were resistant to small pox. The present day method of small pox vaccination with the use of calf-lymph was perfected by

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Edward Jenner in 1796, following the statement made by a milk-maid that she could not contract small pox.

Undulant fever.—This human affection is caused by the ingestion of cow's or goat's milk containing either one or other of the closely related organisms (*Brucella abortus* and *melitensis*) which cause abortion in cattle and Malta fever in goats. In the human disease, the fever shows irregular undulations. The prolonged duration and the complications which follow an attack make the disease a serious one. Pasteurisation of milk is an effective method of reducing risks to man.

Weil's disease or 'Yellows'.—This condition affects rats primarily, but human beings and dogs are also affected. The disease is a form of infectious jaundice, and is caused by a spiral-shaped organism--*Leptospira icterohaemorrhagiae*. Soldiers, sewer workers and ditch diggers are known to be affected, and the organisms probably infect them through the unbroken skin. The usual mode of infection is however through food or water being contaminated by rats. The organisms are found in large numbers in the kidneys and other organs of an affected animal, and they are excreted in the urine (Plate XIII).

To mention a few of the other affections communicated to man by rodents, plague, tularaemia, rat-bite fever and Rocky mountain spotted fever are examples.

Milk-borne diseases.—Of the diseases dealt with already, tuberculosis, foot-and-mouth disease, anthrax, rabies, cow-pox and undulant fever are some of the entities which are transmissible to man through the milk of diseased animals. In the same manner certain forms of plant poisoning (milk sickness), bacterial toxaemias (blood poisoning with bacterial poisons), and ptomain or food poisoning due tô the Salmonella group of bacteria, or some septic and pyaemic diseases, may be communicated through the milk of affected cows. There is again another group of diseases, which are primarily human affections but can be carried passively by cows, or by milk contaminated by milkers or milk vendors who carry the infective germs of the disease in their body though apparently in good health (human carriers). Numerous records of serious outbreaks due to these milk-borne infections, as opposed to animal diseases communicated through milk, have been published, and the diseases implicated are: diphtheria, septic sore throat, scarlet fever, small pox, tuberculosis (human), enteric, typhoid and paratyphoid fevers and mumps. Proper pasteurisation of milk, employment of healthy milkers and milk vendors, and a systematic examination of milk are some of the preventive measures which should be adopted. In addition to the risk of the above diseases being contracted by man, the existence of these infections in many cases produces a marked deterioration of the nutritive values of milk.

Worm infections.—Human beings contract a number of helminthic infections directly or indirectly from animals, and *Echinococcus*, *Trichina spiralis* and the parasites of measly beef and measly pork have been mentioned earlier.

Tapeworms are ribbon-like worms, which in the adult stage consist of a head and a number of semi-independent segments or proglottids. The dog tapeworm, *Taenia echinococcus*, resides in the intestine of carnivora and consists of four segments each containing several hundred eggs. The segments on being passed contaminate food and water and thus infect man and other animals. Dogs are again infected by eating infected meat. The beef tapeworm, *Taenia saginata*, and the pig tapeworm, *Taenia solium*, affect man due to eating improperly cooked meat. Another important pig parasite transmitted from infected meat is a roundworm, *Trichina spiralis*. Salting and other methods of meat preservation are not dependable in destroying the Trichina parasite, and the parasite may live inside calcified cysts for several years. Further, as the serum from affected pigs have been found to be poisonous to susceptible animals, a toxin is probably elaborated by the parasite. It is believed that due to the risk of contracting trichnosis and infection with the pig tapeworm, the eating of pork was prohibited by Moses as early as 1500 B.C.

Roundworms of the pig, *Ascaris lumbricoides*, and the tapeworm of the dog and cats, *Dipylidium caninum*, affect children.

Of the leaf-shaped worms, flukes, *Fasciola hepatica*, *Clonorchis sinensis*, *Opisthorchis felineus* and a few others affect both animals and man, and infected animals are therefore a source of danger to human health.

In India, *Dracunculus medinensis*, the common 'Guinea worm' affects man and dogs in particular The adult females produce nodular swellings and ulcers, and when these lesions are brought in contact with water, a mass of larvae is discharged by the man The larvae infect a species of Cyclops and after developing inside them become infective to man and other animals. A most interesting method of controlling the disease biologically has been evolved, and consists of the rearing of the fish *Barbus puckelli* to feed upon Cyclops and the Guinea worm larvae.

Mycotic diseases.—Moulds and fungi belong to the vegetable kingdom, and are responsible for producing a number of skin diseases and internal infections in mammals and birds. Most animal ringworms (tricophytosis, favus, etc.) are transmissible to man producing intense irritation on the skin, scalp or the beard. The commonest is the calf ringworm which produces large circinate lesions in man (Plate XII, fig. 4). Actinomycosis is another infective disease being contracted from diseased cattle directly or through their milk or meat (Plate XI, fig. 10 and Plate XII, figs. 6-7).

Insect rashes.—The common mange mites, Sarcopt, Psoropt of animals, have been known to affect human beings coming in contact with diseased horses, kittens, etc. Although these acarine parasites usually produce a cutaneous disease, occasionally very drastic results may follow, as outbreaks of death among rabbits have been seen (Plate XII, fig. 5). The bird mite *Dermanyssus avium* and *gallinae*

may provoke intense erythematous and papular irritation. Most of the manges are aggravated by scratching.

The role of insects in the transmission of diseases has already been referred to, and the ticks, fleas, lice, bugs which are involved, are a legion.

Protozoan infections.—A number of protozoan infections are common to man and animals, and of these *Balantidium coli*, Giardia, *Entamoeba histolytica, Leishmania tropica* and *donovani* and *Trypanosoma cruzi* may be mentioned.

To conclude, it has been customary to consider the subject of animal diseases in a narrow and restricted manner, as relating to either agriculture or in relation to communicable diseases of man. Sufficient has been said above to show that the subject is deserving of being treated from a broader perspective of national health and wealth, as greater human activity to-day is concerned with animals and their products; and the contacts between man and animals are likely to increase. In order that human health be not undermined, and the growth of our live-stock wealth be not jeopardised, the progress of the pastoral industries be ensured, and the general development of trade and commerce be not interfered with, it is our duty to create that degree of enthusiasm and conscience in our people in this problem of animal diseases as will eventually produce the desired determination for better things, greater prosperity and more satisfying happiness.

List of diseases transmissible to man

Nature of diseases and their names	Cause	Animals affected	Mode of infection
	Bacterial diseases		
(*a*) Tuberculosis	Tubercle bacilli	Bovines, cat, hog, apes, monkeys, fowls and other birds and Guinea pigs.	Through ingestion and inhalation.
(*b*) Anthrax	*Bacillus anthracis*	Almost all animals	Inoculation, ingestion and inhalation.
(*c*) Glanders	*Bacillus mallei*	Equines, guinea pigs, rabbits, and goats are also susceptible.	Through abraded skin. Also by ingestion and inhalation.
(*d*) Tetanus	*Clostridium tetani*	All herbivorous animals.	Through deep punctured wounds.
(*e*) Gas gangrene	Welch bacillus group	Horse, sheep, Guinea pigs, rabbits, and mice.	By way of wounded tissue.
(*f*) Undulant fever	(1) *Brucella melitensis*	Goats	Through infected milk.
	(2) *Brucella abortus*.	Cattle and hogs	

Nature of diseases and their names	Cause	Animals affected	Mode of infection
	Bacterial diseases—contd.		
(*g*) Botulism . .	Organism of Salmonella group. *S. artrycke* *S. enteriditis.* *S. suipestifer.*	Hogs, cattle, sheep, goats and wild animals and rodents.	Through eating infected unboiled meat, eggs, etc.
(*h*) Swine Erysipelus	*Bacillus erysipelatis suis.*	Pigs . . .	Through abrasion of the skin.
(*i*) Tularaemia .	*Bacterium tularense*	Rabbits and hares .	By blood sucking insects and through contact with infected animals.
(*j*) Impetigo . .	Streptococcus .	Horse . . .	Direct contact.
(*k*) Butcher's pemiphigus.	Coccal infection .	Meat . . .	Wound infection in butchers and purveyors.
(*l*) Plague . .	*Bacillus pestis* .	Rodents, rats and ground squirrels.	Through the bite of an infected flea.
	Virus diseases		
(*a*) Foot-and-mouth disease.	Filtrable virus .	Cattle and other cloven footed animals.	By eating or drinking raw milk products from infected cows and also by infected saliva entering the mouth through some source particularly finger.
(*b*) Rabies . .	Ditto . .	Dogs and jackals and other warm blooded animals.	Through bite of rabid animals or inoculation of infected saliva through abrasions in the skin.
(*c*) Cow-pox . .	Ditto . .	Cattle, specially cows in milk.	By inoculation through broken skin and inhalation.
(*d*) Psittacosis .	Ditto . Probably in association with *B. psittacosis.*	Parrots . . .	Through actual contact with sick parrots.
(*e*) Warts . .	Virus . . .	Dogs and cattle .	Direct contact.
(*f*) Rocky Mountain spotted fever.	Ditto . . .	Rodents . .	Bite of ticks.
	Diseases of human origin		
(*a*) Septic sore throat	*Streptococcus epidemicus.*	Milch cows . .	Through drinking infected milk.
(*b*) Diphtheria .	*Corynebacterium diphtheriae.*	Cats, fowls and cows	Through direct contact and drinking infected milk.

Nature of diseases and their names	Cause	Animals affected	Mode of infection
	Diseases of human origin—contd.		
(c) Scarlet fever .	*Streptococcus scarletinae.*	Cows . . .	Through drinking infected milk.
(d) Typhoid . .	Bacillus of typhoid	Apes, Chimpanzee .	Through contact and ingestion of material infected with bacillus.
(e) Paratyphoid fever	*Salmonella* sp. .	Young calves .	Food poisoning due to infected meat.
	Helminthic infection		
(a) *Tapeworm infection*—			
(1) *Taenia solium*	*Cysticercus cellulosae*	Pigs . . .	Through eating improperly boiled meat.
(2) *Taenia saginata*	*Cysticercus bovis* .	Cattle . . .	Ditto.
(3) Hydatid .	*Echinococcus granulosus.*	Dogs . . .	Ingestion of material contaminated with the droppings of infected dogs.
(b) *Roundworm infection*—			
(1) Trichinellosis .	*Trichina spiralis* .	Pigs . . .	Through eating improperly boiled infected meat.
(2) Guinea worm infection.	*Dracunculus medinensis.*	Horse, cattle and dogs.	Through cyclops.
	Fungus infection		
(a) Actinomycosis .	*Actinomycosis bovis*	Almost all animals .	Through ingestion by eating or drinking infected meat, or milk.
(b) Ringworm .	*Tinea tonsurans* .	Cattle, horse, cat and dogs.	Through abraded skin.
(c) Large spored ringworm.	*Tricophyton tonsurans.*	Horse and cat .	Ditto.
(d) Favus . .	*Achorion schonleinii.*	Dogs, mouse . .	Ditto.
	Arthropod infection		
(a) Acariasis . .	*Dermanyssus gallinae*	Chickens . .	Through biting of mites.
(b) Mange . .	*Sarcoptes scabei* .	All domesticated animals except cat.	Through contact.

Nature of diseases and their names	Cause	Animals affected	Mode of infection
	Protozoan infection		
(*a*) Syphilis . .	*Spirochaeta pallida*	Llmas . . .	Through copulation.
(*b*) *Balantidium coli*	Living cysts . .	Hogs . . .	Through ingestion of contaminated material.
(*c*) Giardiasis . .	Ditto . .	Mice and rats .	Ditto.
(*d*) Amoebiasis .	*Entamoeba histolytica*	Dogs and cats .	Through ingestion of material containing cysts.
(*e*) Leishmaniasis .	*Leishmania donovani*	Dogs . . .	Through the bite of infected fleas.
(*f*) Spirochaetal jaundice.	*Leptospira icterohaemorrhagiae.*	Rats . . .	Contact of abraded surface with materials contaminated with urine or faeces and infected rats, and through the bite of infected mosquitoes.
(*g*) Rat bite fever .	*Leptospira morsus muris.*	Rats . . .	Contact of abraded surface with materials soiled with rats urine or following the bites of infected rats.
(*h*) Trypanosomiasis "Chaga's disease."	*Trepanosoma cruzi* .	Small laboratory animals.	Bed bugs.

EXPLANATION OF PLATES

PLATE XI

Disease producing agents

1. Spirochaetes cause severe disease in poultry.
2. Staphylococci }
3. Streptococci } Pus producing organisms set up a number of diseases in man and animals.
4. Anthrax bacillus causes anthrax in man and animals.
5. Bipolar organisms produce human plague and also animal disease.
6. Tetanus bacilli produce tetanus in man and animals.
7. Tubercle bacilli produce tuberculosis.
8. Fungus mycelia }
9. Budding fungus } Skin diseases and also diseases of internal organs.
10. Actinomyces causes lumpy jaw in cattle.
11. Cryptococcus causes epizootic lymphangitis of horse.

12. Aspergillus causes pneumonia in birds and sometimes in cattle.
13. Leishmania affects man and dogs.
14. Trichomonas produces sterility and abortion.
15. Trypanosomes causes surra in animals and sleeping sickness in man.
16. Amoeba causes dysentery in man and dogs.
17. *Babesia bigemina* causes red water in cattle.
18. *Haemoproteus columbae* occurs in birds.
19. Boophilus (tick) is a vector of red water in cattle.
20. Tabanus—a fly—believed to be the carrier of surra (trypanosomiasis).
21. Demodex causes persistent mange in dogs.
22. Sarcoptes } produce scab in man and animals.
23. Psoroptes }

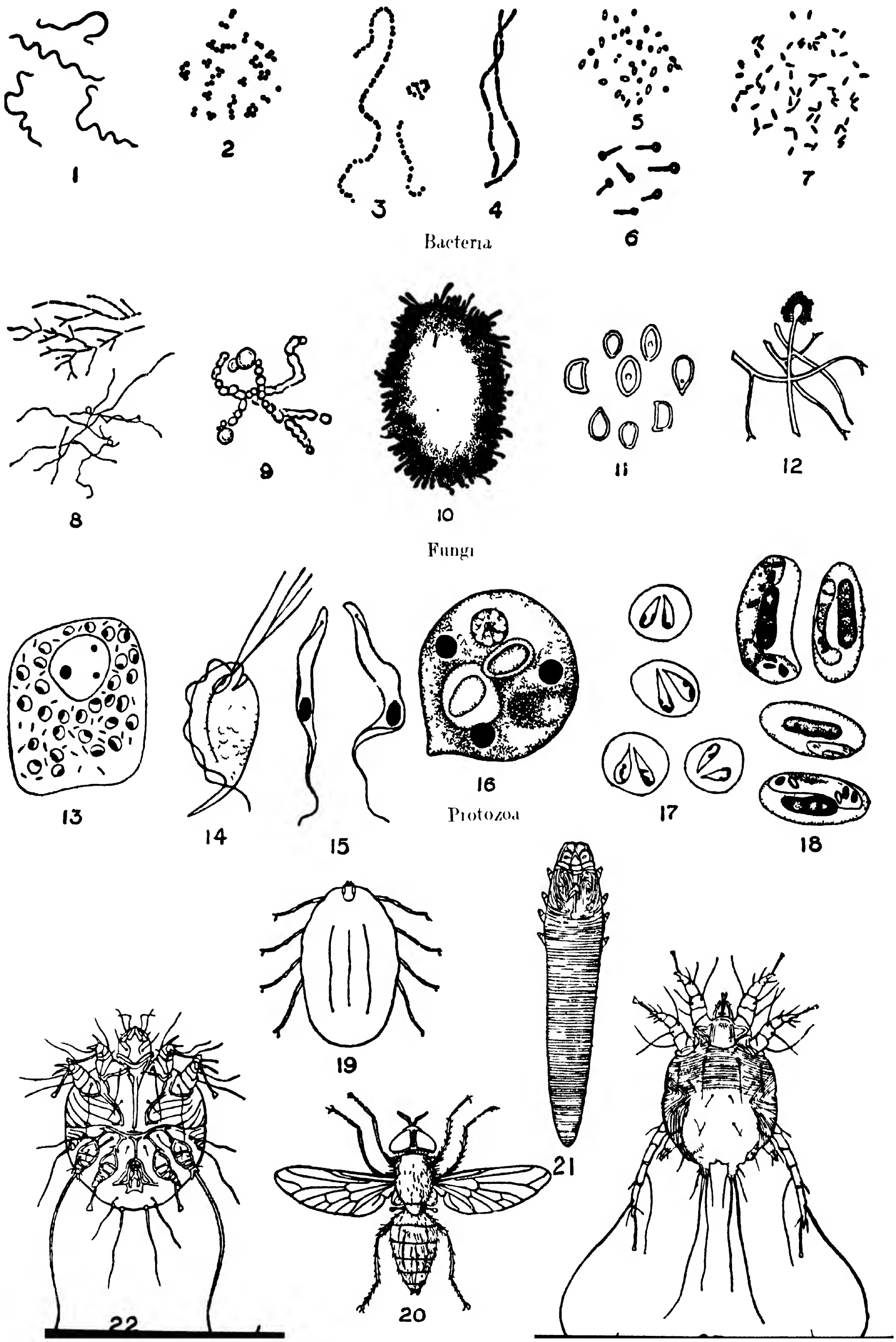
Plate XII

Some chronic diseases of animals in India

1. Hill calf showing generalised ringworm patches (trichophyton infection).
2. Infected hair from the above calf treated with hot caustic potash for microscopic examination—Fungus mycelia and spores seen.
3. Ditto. Hair in tact showing beaded spores.
4. Cow-boy infected on the cheek by a large circinate ringworm from an infected calf.
5. Rabbit in a moribund condition due to extensive infection with acarine parasite mange.
6. Hill bull affected with actinomycosis of the upper jaw bone.
7. The causative fungus of the same in microscopic preparation.
8. Horse affected with lichen tropicus, so-called *khoojlee*, caused by a microfilaria shown at 9.
10. Cattle showing yoke gall complicated with "Calcutta sore", due to a microfilaria seen coiled up in section of the tissue at 11.
12. Rickets in dog—a nutritional deficiency disease. Left dog shows bony enlargement in the limb joint. Right dog shows a normal pup of the same litter.
13. Osteoporosis or 'big head' in a pony—another nutritional disease due to imbalance of phosphorus in relation to calcium.
14. Leucoderma in a pony—Depigmentation around the eye and extending on the side of the face in a symmetrically bilateral manner—believed to be of disturbed metabolic origin, similar to the human disease.

Plate XIII

This plate illustrates how Weil's disease of man produces Yellows or infectious jaundice in dogs, and *vice-versa* through the intermediate agency of rats,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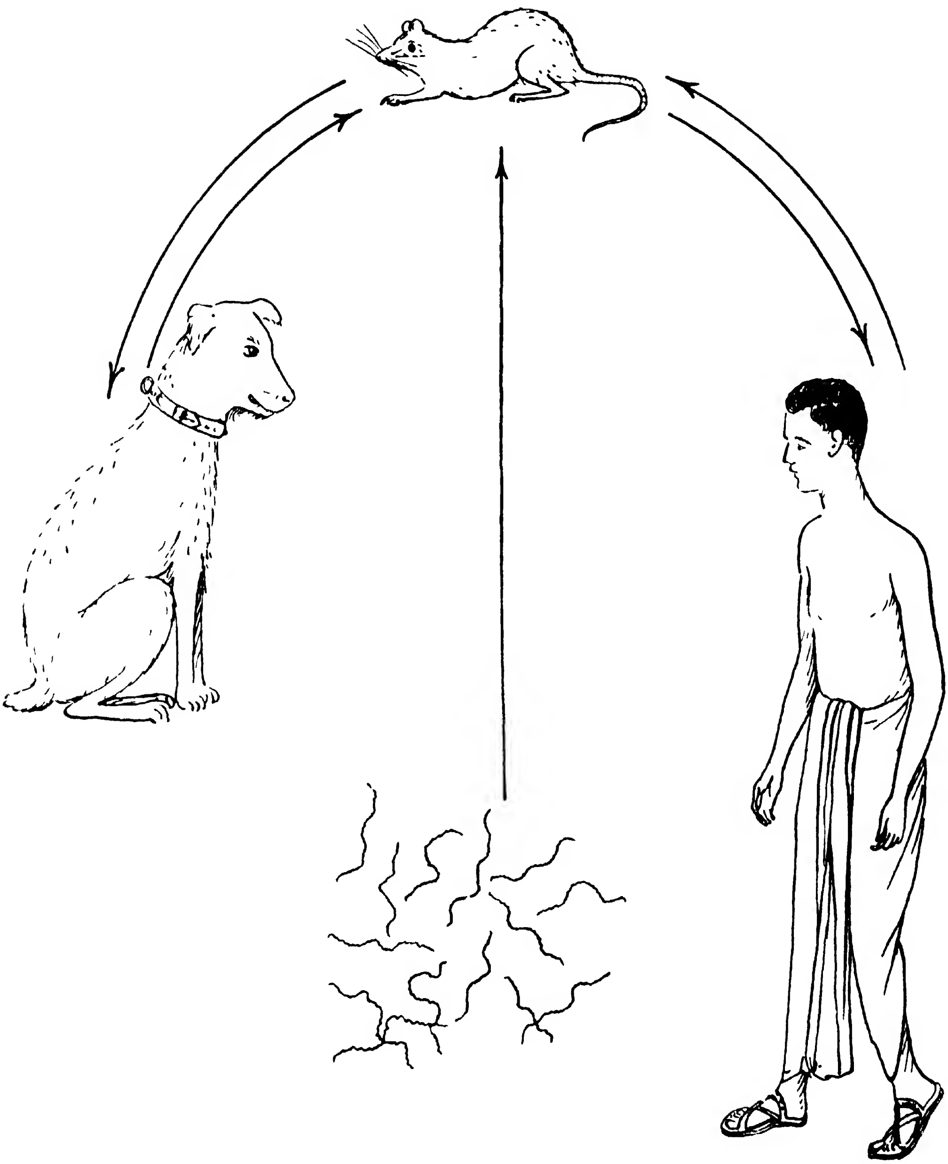
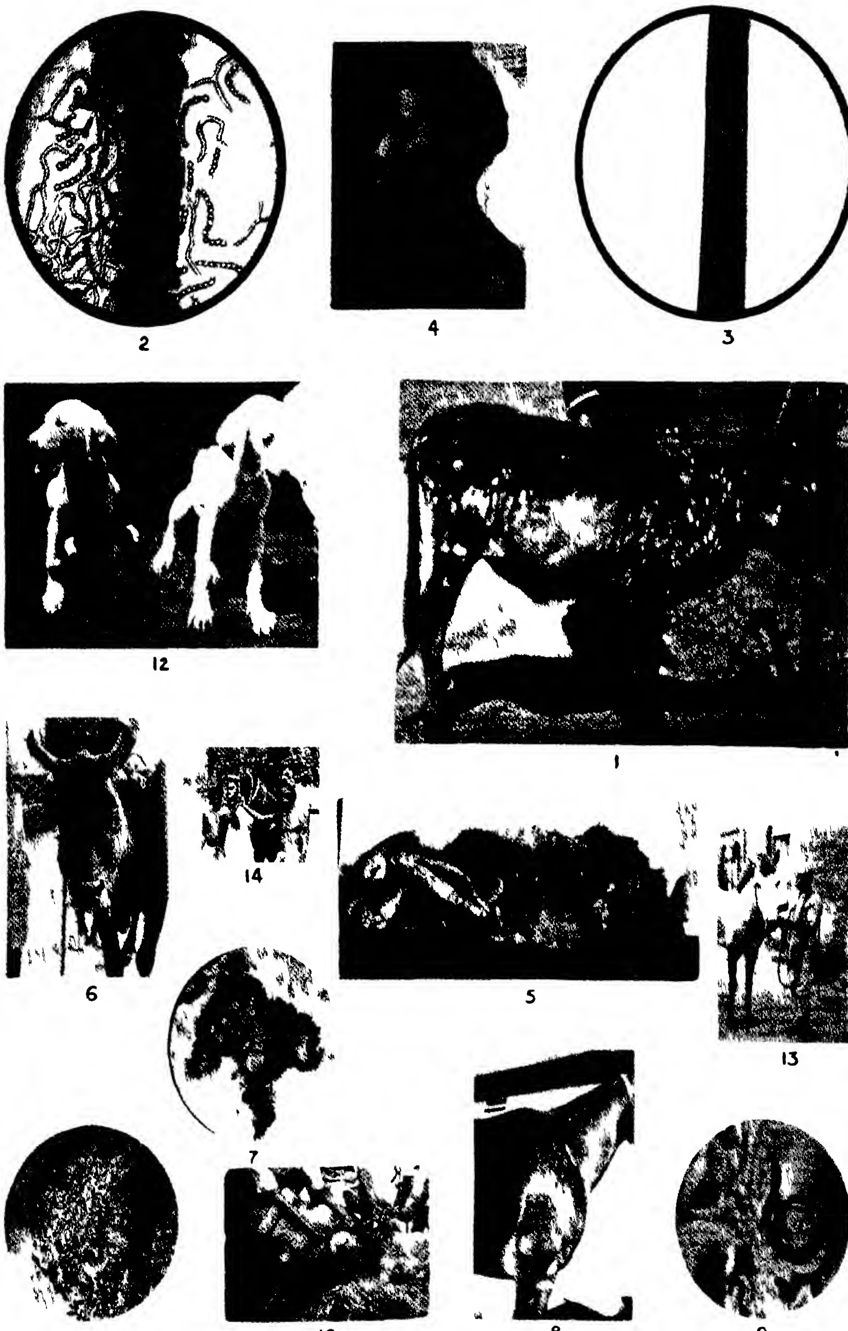
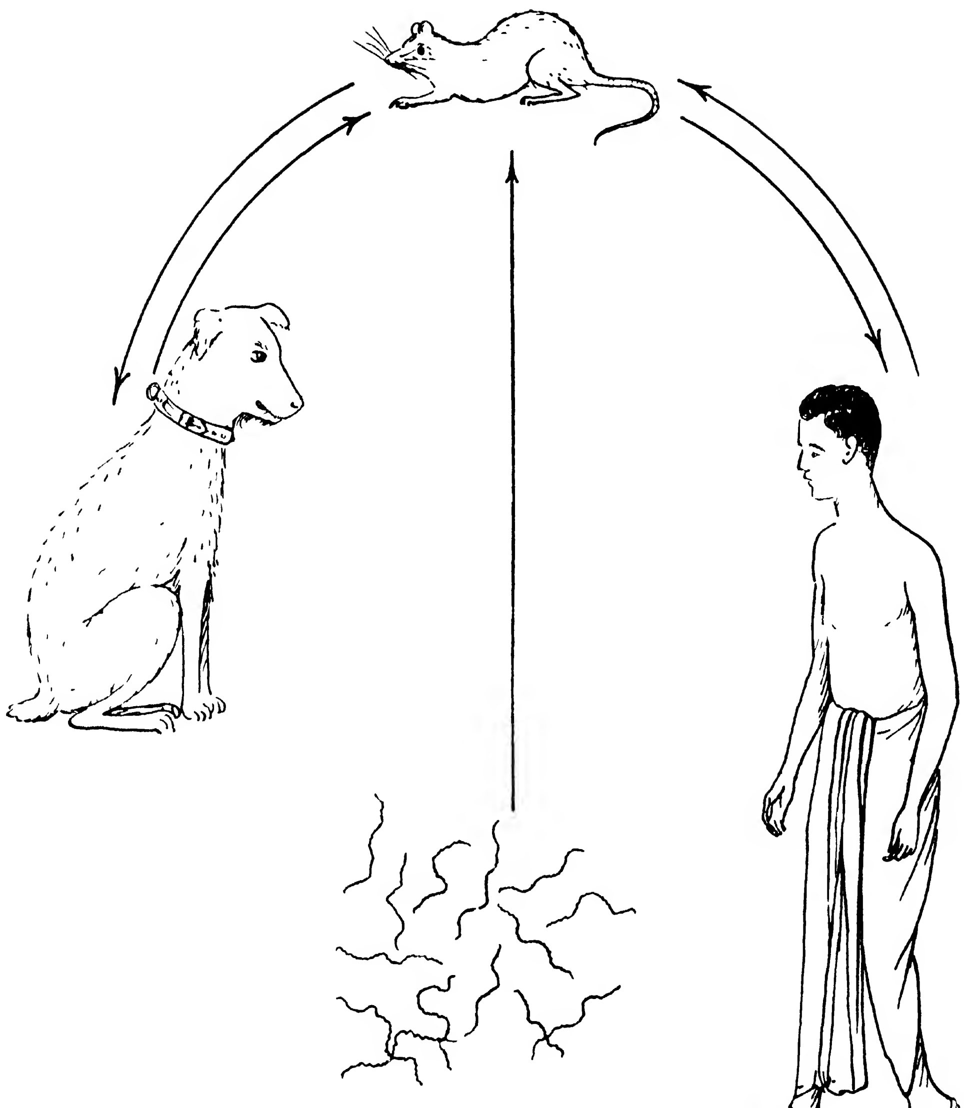
SOME CHRONIC DISEASES OF ANIMALS IN INDIA



Weil's disease or 'Yellows' in dog and man

Some chronic diseases of animals in India





Weil's disease or 'Yellows' in dog and man

UTILITY OF SOIL-INVERTING PLOUGHS AND IMPROVED IMPLEMENTS AS COMPARED WITH INDIGENOUS IMPLEMENTS

BY

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THE Royal Commission on Agriculture in India, in Para. 107 of their Report, after discussing the subject matter of this article at considerable length, remark as follows :—

> "It is clear that the only method by which the superiority of any one of them can be established is by a series of careful experiments carried out over a term of years. It is eminently desirable that further attention should be given to this subject on which evidence based on experiment is lacking ".

Although the Commission were apparently unaware of the fact, the subject had already received some attention from the Deputy Director of Agriculture, Cawnpore, as in the *Agricultural Journal of India*, Vol. XXIV, Part I, this officer describes an experiment started by him in the year 1922 to discover if the use of soil-inverting ploughs gave increased yields. As a result of his six years' work at Cawnpore he states that "The average percentage increase in out-turn of wheat grain and straw, assuming the yield from shallow ploughing without inversion to be 100, is as follows :—

	Per cent
Deep ploughing with inversion	45
Shallow ploughing with inversion	33
Deep ploughing without inversion	13 "

Again, I find from the records of the Lyallpur Farm that a somewhat similar experiment was carried out there in the early days of the Department ; but the results obtained in this case did not indicate any yield superiority in favour of soil-inverting ploughs.

These conflicting results obtained at two different centres may have been due to differences in the climatic condition and soils of the two places. The heavier rainfall at Cawnpore (36 inches) would encourage the growth of weeds, so a soil

inverting plough would be more effective for keeping them in check ; whilst owing to the low rainfall at Lyallpur (13 inches) the eradication of weeds presents no difficulty.

So far as I am aware, these are the only systematic efforts that have hitherto been made to throw light upon the subject until I designed the series of experiments here described.

These experiments were started at Lyallpur Experimental Station in 1930 on perennially irrigated land of average quality which hitherto had been regularly cropped and maintained in clean condition.

For the sake of convenience all soil-inverted plots in the experiment are referred to as ' ploughed plots,' whilst non-inverted plots are referred to as 'cultivated plots.'

Three different aspects of the problem are being investigated in three separate experiments designated Sets A, B and C. The objects of each set are briefly described below :—

Set A—In this case the yields obtained from ploughed plots are being compared with those obtained from cultivated plots ; an equal number of operations being performed in each set of plots.

Set B—In this case the yields obtained from ploughed plots are being compared with those obtained from cultivated plots ; but in this case an equal state of tilth is aimed at in each set of plots irrespective of the number of operations performed in each.

Set C—In this case the yields obtained from plots cultivated with improved implements and by improved methods are being compared with yields obtained from plots cultivated entirely with indigenous implements—according to the ord nary zamindari practice.

In Set A an inverting plough is used for the first ploughing and subsequently only when the land becomes hard. After the original ploughing a horse hoe is used when necessary to stir up the land. The *desi* plough is used for an equal number of operations irrespective of whether the tilth produced is satisfactory or not.

In Set B the implements used are the same as in Set A, but the number of operations performed is different in each set of plots. Efforts are made to produce the same state of tilth in each set ; so far as this can be judged by eye.

In all operations performed up to the sowing stage the ploughed and cultivated plots of both sets are treated as indicated above ; thereafter they are treated alike as regards the kind and number of all cultural and other operations performed

In Set C a combination of what is considered to be the most suitable improved implements are used with the object of producing a good state of tilth with

the minimum expenditure of labour and time. The standard of cultivation followed in the Zamindari plots is that of a selected zamindar resident in the neighbourhood of the Farm. His procedure is watched and followed throughout as far as possible ; even to the time of ploughing, number of ploughings, method of sowing, number of intercultures, weedings, etc. The number of irrigations applied is the same in each case, though they may have been applied at different times.

The plots were purposely selected large, 1/4th acre each, so that they could be readily ploughed or cultivated in either direction. Four repetitions have been arranged with each treatment. The rotation followed is a common one of the locality, *viz.* wheat, *toria*, cotton. The number of irrigations given is the same in all cases.

A record of the number of hours of man and bullock labour employed in each set of plots has been maintained ; also a record of all operations performed in each plot.

Similar experiments have since been started at four other centres in the province where the climatic and agricultural conditions are somewhat different, but these have not yet been sufficiently long in progress to yield any useful information.

The experiment at Lyallpur is still in progress and it is hoped to continue it ; but in the meantime sufficient data have accumulated to enable us to arrive at some conclusions as to the effects of the various cultural treatments given.

The statement appended gives the average yields obtained over the period of the experiment, from the different crops grown in each set, the number of hours of manual and bullock labour employed on each, up to the sowing stage, the cost thereof and the value of the produce obtained. The results obtained are discussed below under three different aspects.

Economic aspect

The financial results of the different treatments are briefly summarised below : The profit (+) or loss (–) in rupees resulting from the use of improved implements is shown in each case.

	Wheat	*Toria*	Cotton	Average net profit per acre per annum in favour of ploughed plots
Set A	+4 3 3	–0 4 6	–3 0 6	+0 4
Set B	+6 5 9	+0 1 9	–5 14 3	+0 3
Set C	+8 14 0	+0 12 9	+12 8 9	+7 6

It will be observed from the figures in the last column that there is no apparent financial advantage in favour of the use of improved implements in Sets A and B where the standard of cultivation of both Sets of plots was high. In Set C, however, the use of improved implements and better cultivation has resulted in a substantial profit.

Interest on capital, depreciation and cost of repairs on implements has not been taken into consideration, so the following additional sums must be debited to the ploughed plots in order to render the figures strictly comparative.

	Per acre
Wheat As. . . .	7·7
Toria As. . . .	5·1
Cotton As. . . .	5·1
Average As. . .	5·96

When the additional cost of the improved implements is deducted from the profits shown in column 5 there is no apparent financial gain from their use except in the case of the Set C plots.

Economy in time and labour

The use of improved implements has in all cases resulted in a considerable saving of time and labour as the following figures show :—

—	Wheat				*Toria*				Cotton			
	Hours of labour saved				Hours of labour saved				Hours of labour saved			
	Man-labour		Bullock-labour		Man-labour		Bullock-labour		Man-labour		Bullock-labour	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Set A . .	19·6	29·7	19·6	29·7	14·0	30 6	14·0	30 6	11·2	24·6	11·2	24·6
Set B . .	14·9	21·7	14·9	21·7	12·1	21·1	12·1	21·1	10·6	19·6	10 6	19·6
Set C . .	8·6	13·3	8·6	13 3	6 9	15·3	6·9	15 3	2·6	6·9	2 6	6·9

The average saving in time and labour amounts to about twenty per cent.

Effect of improved implements on yield

Detailed yields are given in the appended statement ; those pertaining to each crop are discussed separately below :—

Wheat—In Set A where an equal number of operations have been performed with indigenous and improved implements the yields are practically the same.

In Set B the use of improved implements has increased yields by approximately 3·8 per cent of grain and 3·3 per cent of straw.

In Set C, improved implements have increased yields by approximately 11·3 per cent of grain and 10·2 per cent of straw.

Toria.—In this case there is no significant difference between the yields obtained from plots under the various treatments.

Cotton—In Sets A and B the cultivated plots have given higher yields by approximately six and ten per cent, respectively.

In Set C the use of improved implements and line sowing has given an average increase in yield of 16·3 per cent.

General observations

The inferences to be drawn from the experiment at the present stage seem to indicate that in a dry climate like that prevailing at Lyallpur where weeds are easily kept in check furrow-turning ploughs and improved implements are not required to the same extent as in areas of heavier rainfall, or where weeds are more abundant. The use of improved implements, however, results in deeper, better and cleaner cultivation and in a twenty per cent saving in time and labour.

The work already done merely serves to emphasise the necessity of making a much wider study of the subject in different parts of the country under varying conditions.

Statement of results

	Averages				Value of produce	Cost of preparatory tillage	Profit (+) or loss (−) in favour of improved implements
	Yield per acre		Hours of man-labour	Hours of bullock-labour			
	Grain	Straw					
	M. S.	M. S.	Hrs.	Hrs.	Rs.	Rs.	Rs.
			Wheat				
Set A							
1. Cultivated . .	25 18	56 25	66·0	66·0	94 1 0	12 6 0	
2. Ploughed . .	25 21	57 17	46·4	46·4	94 9 3	8 11 0	+4 3 3
Set B							
1. Cultivated . .	26 15	60 22	68·8	68·8	98 1 6	12 14 3	
2. Ploughed . .	27 14	62 22	53·9	53·9	101 10 3	10 1 3	+6 5 9
Set C							
1. Zamindara practice	17 24	41 4	64·5	64·5	65 10 9	12 1 6	
2. Improved implements . .	19 23	45 12	55·9	55·9	72 14 6	10 7 3	+8 14 0

STATEMENT OF RESULTS—*contd.*

	Averages				Value of produce	Cost of preparatory tillage	Profit (+) or loss (−) in favour of improved implements
	Yield per acre		Hours of man-labour	Hours of bullock-labour			
	Grain	Straw					
	M. S.	M. S.	Hrs.	Hrs.	Rs.	Rs.	Rs.
Toria							
Set A							
1. Cultivated . .	9 6		45·8	45·8	36 10 9	8 9 3	
2. Ploughed . .	8 17	..	31·8	31·8	33 12 3	5 15 3	−0 4 6
Set B							
1. Cultivated . .	8 32	..	57·3	57·3	35 4 3	10 11 9	
2. Ploughed . .	8 11	..	45·2	45·2	33 2 0	8 7 9	+0 1 9
Set C							
1. Zamindara practice	8 28	..	45·0	45·0	34 13 6	8 7 0	
2. Improved implements . .	8 23	..	38·1	38·1	34 5 3	7 2 0	+0 12 9
Cotton							
Set A							
1. Cultivated . .	10 23	..	45·5	45·5	84 10 6	8 8 6	
2. Ploughed . .	9 37	..	34·3	34·3	79 8 3	6 6 9	−3 0 6
Set B							
1. Cultivated . .	11 28	..	54·0	54·0	93 11 9	10 2 0	
2. Ploughed . .	10 29	..	43·4	43·4	85 14 0	8 2 6	−5 14 3
Set C							
1 Zamindara practice	9 7	..	37·5	37·5	73 8 0	7 0 6	
2. Improved implements . .	10 27	..	34·9	34·9	85 8 6	6 8 3	+12 8 9

Remarks :—The produce has been valued as under :—

	Per maund Rs. A. P.
Wheat grain	3 0 0
Wheat straw	0 5 0
Toria	4 0 0
Cotton	8 0 0

The labour was valued as under :—

	Per 8 hours Rs. A. P.
Hours of man-labour	0 8 0
Hours of bullock-labour	1 0 0

A NOTE ON 'QUALITY' OF COFFEE

BY

RUDOLPH D. ANSTEAD, M.A., C.I.E.

WHAT exactly is meant by the " quality " of coffee ? How is this property best judged ? On what inherent properties does it depend ? How can quality be maintained, and, if it is apt to deteriorate, how can it be restored ?

The problem revolving round such questions is no new one. In the early days of the United Planters' Association of Southern India, we find it being discussed at their Annual Meetings and year after year the discussion has continued, as an examination of the Proceedings will show.

This note is meant to summarise the various attempts which have been made over a long series of years to deal with this subject. These attempts have been tentative and they lack cohesion, but a study of what has been done may be of use to those who are now taking up the matter seriously on a scientific basis, and may possibly indicate useful lines of approach. The list of references to the different literature on the subject may also prove of value though it is very incomplete.

One of the outstanding difficulties in the way of the study of quality is that there is no reliable standard of quality. Indeed it is difficult to know exactly what is meant by the term. The most commonly used test of quality is the liquoring test, but this is too dependent upon the personal element to appeal to the scientist. Moreover it is difficult of application in India where experiments on the improvement of quality must be conducted. The scientist needs a test which has if possible a numerical expression, and which will not vary. It ought to give the same results no matter who uses it, or where and when it is used.

As long ago as 1886, the Wynaad Planters' Association carried out an extensive series of experiments in drying coffee with a view to improving its quality, and published a pamphlet on the results called " The Colour of Coffee ". Whether any copies of this pamphlet still exist it is difficult to say. The beans were dried under thin coir matting and coffee thus prepared fetched better prices.

In 1911 experiments were undertaken with artificial drying on an estate in Mysore. These indicated that evenness of drying had a beneficial effect on quality. Artificial drying, however, did not prove popular owing to the cost involved, and possibly a natural opposition from the coast curers, and the matter was dropped.

Another suggestion which has been made is to grade the cherries before they are pulped. As far as the writer is aware no experiments along this line have been carried out on Indian estates, but it might be worth attention.

In 1903 a study of quality was begun on a scientific basis by Dr. Lehmann who had come in 1900 to the Mysore Government as an Agricultural Officer. He did some very valuable work on the subject during the short time he was there of which sight should not be lost by modern investigators. Lecturing at a meeting of the United Planters' Association of Southern India in 1903, he said that the quality of coffee was probably dependent upon a number of factors, some of which were controllable by the planter, and he first advised a careful selection of seed.

The possibility of improving quality by hybridisation has received a great deal of attention. With a crop like coffee this is a slow process, but it contains great possibilities. A certain amount of seed selection work and actual hybridisation work was carried out by the writer in conjunction with Mr. Jackson in Coorg and Mr. Kent in Mysore, and a history of this work and the results achieved will be found in the pages of the Planters' Chronicle.

The quality of coffee no doubt depends on its chemical composition. At one time it was supposed to be correlated with its caffein content but this cannot be so entirely as tea contains the same alkaloid and the taste of tea and coffee differ widely. Hence this theory was abandoned as a possible standard.

Dr. Lehmann undertook the careful analysis of five different samples of coffee which had been sold in London and had realised prices varying from 59*s.* to 80*s.* per cwt In these samples colour and size had failed to indicate the market price which was taken as a standard of quality. The sample which ranked highest in this respect had realised almost the lowest price, and the sample which fetched the highest price had almost the smallest beans.

Dr. Lehmann conceived the idea that the compactness of the beans, and their nitrogen content, might be made an index of their quality. The higher the specific gravity the larger the percentage of nitrogen was likely to be. Generally speaking this was found to be the case, but the differences were very small, and the number of analyses made too few in number to lay down a definite rule at this stage of the investigation.

The results of these analyses were as follows. They are of great value as being the first made along these lines, and they remain historic.

	Price in shillings per cwt.	Specific gravity	Nitrogen per cent	Organic matter per cent	Phosphoric acid per cent
1	80	1·268	2·5	95·79	0·45
2	77	1·267	2·3	95·54	0·45
3	60	1·258	2·3	95·88	0·44
4	59	1·259	2·3	95·83	0·43
5	59	1·250	2·3	95·78	0·43

The chemical composition of these five samples is surprisingly similar and the small differences can hardly justify the differences in the prices obtained. A certain correlation between price, and therefore quality, and specific gravity and nitrogen content is however indicated.

In 1904 Dr. Lehmann returned to the subject. He had then received and analysed 51 samples of coffee collected from different parts of the world. The results confirmed his first opinion that specific gravity was directly correlated to price and therefore presumably quality as judged by the market. He considered that specific gravity might be safely used as a numerical index of quality until a better test can be discovered. The figures of these analyses were apparently published in the Annual Report of the Mysore Agricultural Department of 1904 or 1905, but are not now available to the writer.

In 1906 Dr. Lehmann said that as a result of further study he found that size and chemical composition of the berry gave absolutely no index of quality, and specific gravity was the only indication of quality that he could find. He was unable to say what exactly constituted quality, but specific gravity was undoubtedly an index of quality.

In 1909 the writer came to India as Scientific Officer for the planters. Owing to pressure of work in connection with other crops and for many years lack of a laboratory, he was unable to take the study of quality of coffee much further. He was, however, able to endorse Dr. Lehmann's opinion that specific gravity is the best index, and probably the only practical index, of quality as judged by price, and he still holds the opinion that this easily-determined property will be found the most practical way of judging quality and testing the effect of manuring or cultivation processes on quality.

Another important factor which must have a decided effect upon quality is the presence on many estates of patches of coffee suffering from old age, borer, stump rot, etc., which yield a low-grade sample. An investigation showed that in many cases patches of coffee on average estates produced seventy per cent of their crop on only twenty per cent of the bushes. This state of affairs must have a profound effect on the quality of the crop in bulk, and indicates an obvious line of attack along cultivation lines.

It must be remembered that India is a big country as compared with England, and though on a small-scale map the coffee districts of Southern India may appear to be closely grouped, actually the distances between one district and another are considerable. At the same time the soil, climate, and elevation of the different districts vary considerably. Consequently, both the quantity and quality of crop may vary a good deal from year to year in the different districts when one is compared with the other. Could the whole of the coffee produced be bulked it would probably tend to produce a more even quality. This is of course impossible;

nevertheless in this connection it is of interest to note what was said in an article on Tanganyika which appeared in the *Times* of 5th August 1937.

> "One interesting item in the increasing native production is the 2,000 tons of Arabica coffee marketed by the Kilimanjaro Native Co-operative Union Limited. Of the 36,000 farmers on the coffee bearing slopes, 24,000 are members, divided into 26 societies which correspond with the chieftainships into which the streams, running down from the snowy summit, cut the mountain side. Each society has its own office, store, and weighing shed, and here a queue may be seen in the picking season, from men with sacks down to little children with baskets. They pour their hulled coffee into the containers of a machine which registers the weight upon a large dial for all eyes to see. The producer then draws a proportion of the estimated price, returning for the balance when the whole crop has been sold. The members engage their own clerks and staff for spraying against diseases and elect their own local committee and their representatives to the union. Their British secretary is, inevitably at this stage, the keystone of the system. The product has the advantage over some neighbouring European plantations in that it is grown round the homesteads and has the advantages of the manure from the cattle stalled in the dusk of the little dome-shaped huts, and of the shade and mulch of the banana groves which make one green cloister of the mountain slopes. The wide variety of soil and climatic conditions over the wet half of the great mountain gives the pooled crop a uniformity in quantity and quality that a single estate can hardly maintain."

It will be seen that many suggestions for the general improvement of quality have been made, and that a certain amount of work on the subject has been done. Some of this is undoubtedly of use, but it needs consolidation and organised experiments with a standard test by which the results of an experiment can be judged. On the eve of his departure from India Dr. Lehmann said that, though his analyses of coffee were still incomplete, determinations of chemical constituents had been completed sufficiently "to indicate that none of them are in themselves of much value in determining the quality and for experimental purposes the specific gravity of the bean is the most convenient and at the same time the most reliable index of the quality of coffee we possess at present."

This is also the considered opinion of the author of this note who can only hope that it may indicate what has been done in the past and prove of some use to future workers on this difficult and important subject of the quality of coffee.

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VITAMIN-A STUDY OF GHEE. PART VII. PRO-AND ANTI-BODIES

BY

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THE remarkable resistance of vitamin A in ghee to the action of heat and air [Banerjee and Dastur, 1937], and the divergent results obtained by others, as discussed in the previous paper, led to the conclusion that other natural pro- and anti-bodies present in ghee were partly responsible for the results. Therefore, it was necessary to study the action of some of them on the vitamin A content of ghee. Vitamin A being thermostable, it is possible to study the action of such agents at a high temperature and reduce the time of the experiment from days to hours. Again, the anti-bodies have been found to act differently with different media, so that their action on ghee and vitamin A is interesting in many ways [Olcott and Mattill, 1936].

The action of hydroquinone, sodium citrate, sodium tartarate, acid ghee, oleic acid, butyric acid, carotin, hydrogen gas, nitrogen gas, and carbon dioxide gas on the vitamin A was studied. The pro and anti number of many of these bodies have been studied [Lea, 1929, 1934 ; Olcott, 1934 ; Mattill, 1931]. Vitamin A being more sensitive and delicate offers a better criterion than rancidity development. Unfortunately the Carr and Price blue test is affected by inhibitors and exhibitors of colour present in the medium. The results, therefore, though not strictly quantitative are useful from industrial and practical considerations.

The materials used in the experiments were obtained from the Imperial Dairy Institute, Bangalore. The butter obtained was fresh, unsalted, and uncoloured. Ghee was prepared by first melting the butter in an air-oven at 100° C. until the aqueous layer collected at the bottom, leaving the fat layer at the top. The water layer was removed with a pipette, and the fat layer was filtered through cotton wool, to free it from the curd. The molten fat was then heated to 110° C. for a few minutes to remove the moisture and develop the ghee odour. All vitamin A determinations were made colorimetrically on the unsaponifiable fraction with antimony trichloride reagent and expressed in Lovibond Tintometer units.

The method of trial was to maintain the ghee at about 96° C. in a paraffin bath for different lengths of time, with the added materials and then estimating the vitamin loss with time.

Hydroquinone in weighed amount to make the solution in ghee 0·03 per cent was added and the vitamin loss with time was determined. Only 0·03 per cent was used as that is the quantity used by the League of Nations Health Organisation in their International Standard for vitamin A as an anti-oxidant.

Sodium citrate and sodium tartarate were added to ghee in their saturated solution in quantities to make up 0·2 per cent in ghee and then experiments were performed.

Two samples of ghee supplied by merchants of acid value 4·2 and 3·2 were used in the experiments.

One drop of butyric acid and oleic acid in 25 c.c. of ghee, or roughly 0·15 per cent of the acid in the sample were used.

Carotin separated from green grass, carrots, and unsaponified fraction of butter-fat were used in these experiments. The yellowness of the sample was used as the criterion of the carotin strength.

The gases hydrogen, nitrogen, and carbon dioxide were bubbled through the ghee in a potash bulb maintained in the hot bath Electrolytic hydrogen after passing through soda lime and calcium chloride towers was used. Nitrogen was obtained from a gas cylinder and used. Carbon dioxide was generated from marble by the action of acid and then used after washing and dehydration.

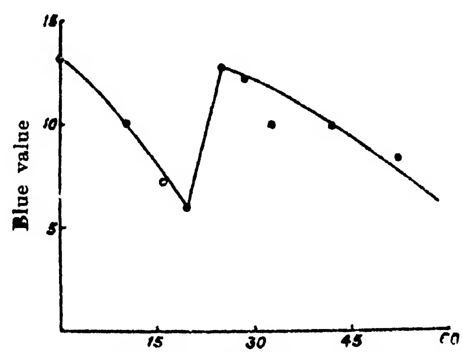
The results are given in Table I.

TABLE I

Serial No.	Name	Vitamin value in Blue units per gram											
		Time of heating in hours											
		0	4	10	12	15	16	20	25	30	40	50	60
1	Sodium tartarate .	16		10						9		7	5
2	Sodium citrate	16		10						9		7	4
3	Hydroquinone	16			10		9		7			5	
4	Acid ghee, acid value 3 2	10	trace										
5	Ditto 4·2	10	trace										
6	Oleic acid 0·2 per cent	16	trace										
7	Butyric acid 0 2 per cent	16	trace										
8	Carbon dioxide gas .	16		15		8		trace					
9	Nitrogen gas .	16		10				14	12	11	..	...	...
10	Hydrogen gas . .	14		10			7	6	13	11	10	10	...
11	Carotin . . .	Yellow value in Lovibond Yellow units per gram.											
	(a) grass .	0 hrs. 1·4	5 hrs 0·7	7 hrs 0·7	9 hrs 0·5	11 hrs. 0·5							
	(b) carrots . .	0 hrs 10	3 hrs 7 2	5 hrs 6·9	7 hrs. 6·6	9 hrs 5·1	12 hrs. 3·6	24 hrs 4·5	30 hrs 4·4				
	(c) ghee . .	0 hrs. 30	12 hrs. 20	19 hrs. 15	25 hrs. 7	30 hrs. 7	40 hrs. 6						

The action of hydrogen gas (Graph A) on heated ghee was very interesting in that at first it had a neutral action on the vitamin loss, but after some time, it reduced or restored the vitamin lost with time to a little less than its original values and withstood the action of heat for a considerable length of time. This result, very interesting as it proved, was repeated a number of times with different samples of cow and buffalo ghee It was next thought that the colour reaction with antimony trichloride might be the result of some reduced molecular complex that reacted with the reagent and gave rise to the colour. In order to verify this point instead of the colour reaction, spectrophotometric absorption at 328 m μ on the unsaponifiable fraction was tried. It was found that absorption at 328 m μ failed to be of any use, with heated ghee samples. While fresh samples of ghee gave the absorption at 328 m μ, it failed to do so after a few hours of heating This proves that while the colour test and biological test give positive values with ghee heated for a small period of time, the spectroscopic test fails because of general absorption or other causes due to the presence of other bodies along with vitamin A in ghee.

Graph A

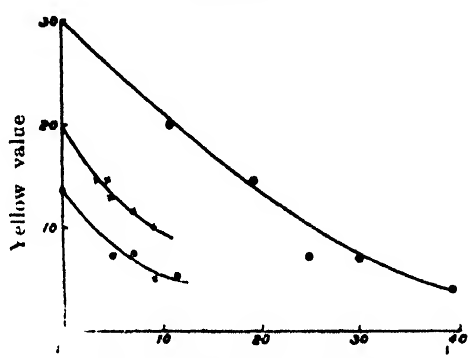


Discussion

Of the anti-bodies tried hydroquinone appears to be very useful. However, the sodium salts of tartaric acid and citric acid are helpful in that no objection can be taken to their presence, in a food material like ghee. Carotins obtained from three different sources act as anti-oxidants in the same way. Some regard carotin as pro-oxidant and others as anti-oxidant. Bradway and Mattill [1934] find that crude carotin is anti-oxidant but pure carotin is pro-oxidant. Carotin from grass is associated with xanthophyl and other materials. But carotin from carrots is almost pure β carotin and contains no xanthophyl. While the unsaponifiable matter from ghee contains β carotin, xanthophyl, vitamin A, and cholesterol However, their rate of loss is the same (Graph B). The action of carotins, xanthophyl, and other bodies associated with natural fats on vitamin A storage requires critical investigation. Carbon dioxide gas is without any

action on vitamin content. Nitrogen gas is useful and retards auto-oxidations. It should be preferably used to drive off dissolved gas or oxygen from oils and fats containing vitamin A and to maintain an inert atmosphere for storage. In a trial, ghee was heated at high temperatures *in vacuo* but no anti-oxidation effect was noticed. This shows that nitrogen gas has more than a mere neutral effect on vitamin A auto-oxidation The regeneration of blue colour after bubbling hydrogen gas through ghee requires thorough investigation because of its potentialities. In the first place, if it reduces oxidised vitamin A, it may be very helpful in restoring poorer quality of ghee to its original value Kuhn and Brockman [1932] have made a careful study of the oxidation of β carotene, and their isomer α and γ carotene. According to them, depending on the oxidation undergone and the presence or absence of a β ionone grouping of β carotene molecule, growth promoting action will depend. Thus β oxy-carotene and semi β carotenone are potent in growth promoting factor, while oxy-carotene and β carotenone are not so It is possible that the action of bubbling hydrogen through ghee results in the reduction of the oxy-carotene, β oxy-carotenone or their semi-oxidised product and therefore the restoration of the blue colour. This is maintained for some time due to the action of hydrogen gas till polymeric or other changes are brought about due to the prolonged action of heat. In a mixed product like ghee where carotene, xanthophyl, sterols, and vitamin A are present it is not easy to follow the action of hydrogen Still, the importance of the reaction requires the reaction to be thoroughly investigated

GRAPH B



The spectrophotometric estimation of vitamin A in ghee by measuring the absorption value at 328 m μ is liable to serious error if any change has taken place due to heat, storage, and other causes. Robinson [1937] and Smith and Robinson [1937] find similar results on their study of vitamin A concentrates, their stability, and oxidation

Hume [1937] has similar experience with spectrophotometric absorption values,

Acidity in ghee, whatever be the cause of development, is highly pro-oxidant and destroys vitamin A very rapidly.

My grateful thanks are due to Dr. Aykroyd of Nutrition Laboratory, Coonoor, for enabling me to perform the spectrophotometric absorption studies mentioned in this paper. Mr. N. K. De very kindly helped me in these studies and performed independent trials with hydrogenation of ghee to check the results chemically and spectrophotometrically. Prof. Subrahmanyan took keen interest in this work and the author is indebted for his helpful suggestions.

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VITAMIN-A STUDY OF GHEE. PART VIII. ACIDITY

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It was found that the results obtained from vitamin studies on ghee when applied to market samples of butter or ghee were irregular. The materials used for these studies were fresh samples of butter obtained from the Imperial Dairy Institute, Bangalore, melted into ghee, and stored in the cold. The market samples were more acidic and generally poorer in vitamin content. The stability of vitamin A was also poor. While acidity is bound to produce its adverse effect on the vitamin potency and storage of ghee, it was thought necessary to study the course of acid development in the process of ghee manufacture as also the possibility of keeping down the value to minimum or of reducing its strength if produced.

The production of acidity in milk or its products is commonly termed "souring" and is due to the action of bacteria on lactose to form lactic acid. Fresh milk has a hydrogen ion concentration of pH 6·5, which is on the acid side of neutrality. Normal fresh milk when titrated with alkali shows an acidity of 0·10 to 0·14 per cent calculated as lactic acid. However, milk is amphoteric in reaction due to casein and is highly buffered due to phosphates in solution. Milk sugar occurs in milk to the extent of about 5 per cent. It varies very little in quantity, seldom falling below 3·5 per cent or rising above 5 per cent. If all the lactose were to ferment to form lactic acid, it would give one gram of lactic acid from each gram of lactose. Such an ideal change, however, never takes place and the highest amount of acid produced from one gram of sugar is 0·8 of a gram. The by-products that accompany lactic fermentation are many and various, carbon dioxide, methane, hydrogen, nitrogen, alcohol, formic acid, acetic acid, succinic acid, and others. In the ordinary souring of milk the fermentation proceeds until an acid percentage of 0·8 to 1·0 is present at which point acid itself inhibits further growth of organisms which produced it. As a rule, not over 10 to 30 per cent of sugar is used up in the normal souring of milk. If the acidity were neutralised, the acid-forming bacteria would again develop acidity to the maximum extent it can tolerate. When milk is used for butter making the lactose goes chiefly into the skim milk. In the fermentation preceding the

churning some of the lactose will be converted into acids although 80 per cent will be still in the buttermilk. A very small amount will be carried into butter dissolved in the water of the butter. This small amount may be entirely converted into acid within a few days.

The enzyme lipase present in milk will act on the butter-fat and develop acidity unless inactivated. While it is not the purpose of the paper to study acidity in milk or cream, it has to be found out as to how much of acidity will find its way into ghee from such causes.

Acidity can be expressed in a number of ways. Acid value of ghee or any fat is the number of milligrams of caustic potash required to neutralise the acidity of one gram of the material. Acid per cent is the weight of acid present in hundred parts of the fat expressed in terms of either as lactic or oleic acid. In this paper the acid per cent is expressed in terms of lactic acid.

Acidity is one of the important factors that bring about autocatalytic oxidation of fats. Butter-fat being rich in butyrin which is very unstable among the fatty glycerides is susceptible to rancid changes. Butter-fat or ghee should therefore be prepared as free from acidity as possible. Vitamin A being more sensitive to autocatalytic agents will suffer most from this defect if not remedied.

To prevent acid development ghee may be prepared from milk as quickly as possible without allowing any souring to take place. However, fresh milk has a slight acidity and even if this were neutralised, no butter or ghee is made in this way. Milk or cream is always allowed to sour more or less before preparing butter or ghee, otherwise the characteristic aroma will be absent. An experiment was performed in this line. Nine pounds of milk of acidity 0·12 per cent and of 3·7 per cent fat content was centrifuged in a cream separator when twelve ounces of butter was prepared. This was melted and separated when 123·5 grams of ghee was obtained. The time taken in the process was two hours. The yield was 82 per cent and acidity 0·046 per cent and acid value 0·29. The butter had no smell and the ghee even on prolonged heating was very poor in aroma. In another trial the cream was neutralised and ghee prepared as above, when the acidity was 0·024 per cent and acid value 0·15.

Butter or ghee is prepared in two ways, *via* the cream or curd, after proper bacterial action. The souring or ripening of cream has been practised from time immemorial. The flavour of butter is due to the organism that predominate it. The acid fermentation is a factor of great importance in butter and cheese industry. The typical butter flavour is due in part to products of sugar fermentation. However, the most important part due to the acidity formed is the checking of the growth of undesirable organisms. But for this fact, dairy products would rapidly undergo decomposition and be unfit for food. Butter can be prepared from cream either sweet or sour, and ripened with or without a starter. The souring of cream has been extensively studied and the following facts are

well known [McKay and Larsen, 1922; Eccles, Combs and Macy, 1929]. A slight acidity is necessary for cream separation. Unless cooled immediately after milking lactic and other fermentation start in milk. The acidity brings about changes in the casein and when the acidity is high curdling takes place. When about 0·5 per cent acid has developed in milk, free casein combines with acid and forms casein lactate. When milk contains 0·3 per cent acid, it will usually coagulate when heated. In a good starter with cream ripening an acidity of 0·7 per cent can be obtained while with a poor starter 0·5 per cent cannot be exceeded with 30 per cent cream. The quality of butter depends on the condition of cream entering the churn. The temperature is the most important factor in churning, still, a sweet cream is viscous and fat globules do not unite readily. The riper the cream, it is easier to churn. In a very sour cream the fat loss is high. Washing removes buttermilk and thorough washing is necessary with impure cream. Excess of washing should be avoided as it removes odour. For good keeping quality butter must have buttermilk washed out of it. Butter made from low acid cream keeps better in storage than that from high acid cream. Good butter can be prepared from sour cream after neutralisation. Butter cannot be stored for any length of time unless kept below —10° C. In a hot country like India, butter is melted into ghee to prevent decomposition. In order to determine the acidity that will pass into ghee, a sample of cream was allowed to sour progressively and samples of ghee were prepared from the butter from time to time.

Sample of ghee acidity (acid value).	Time of souring of cream at 0°C. Hrs.	Acidity of cream Per cent
0·27 or 0·046 per cent	12	
2·27 or 0·36 per cent	84	0·18
6·66 or 1·06 per cent	156	0·198
3·46 or 0·55 per cent	204	0·260

It will be seen that with progressive souring the acid value of ghee also rises in value until the casein is attacked when it goes down but takes up undesirable flavour and colour.

In another trial, ghee was prepared from ripened cream as usual when its acid value was found to be 0·99. A part of the same cream was neutralised with lime (acidity of cream 0·46 per cent) and then churned and washed to prepare butter. The butter was melted and the acid value of ghee was found to be 0·38. The improvement in acid value is 60 per cent when it is borne in mind that high acid cream will take up a large quantity of lime and form lime caseinate. Overman [1936] finds that different neutralisers have no effect on the butter, as regards flavour or storage quality. In the villages, however, ghee is prepared *via* the curd process. The milk is heated to boiling after collection

and then inoculated with a small quantity of curd. After a certain interval of time depending on the temperature when milk has curdled to the required degree it is churned. Every housewife or milk-man has experience to guide in the matter. The churning is done in a crude fashion and the yield is poor. However, the separated curd has a market value and this helps to make up for the poor yield in ghee. In spite of the crude process some of them can be compared with the best product of a modern creamery. In a trial, 9 lbs. of milk was curdled and then the butter separated in exactly the same way as practised in a village. The yield of ghee was poor and only 30 per cent of the total fat content. The acid value of curd was 8·45 before churning. The acid value of the ghee was 0·54.

Lately, the acidity in butter has been attempted to be lowered in a number of ways. Acid content of butter is reduced by washing with milk or skimmed milk, the acid content of which has been reduced, by electro-chemical means to the required degree of acidity determined beforehand. (*A. C. S., Abs.* **29**, 852, 1935). Karpeles [1935] used de-acidified milk, whey, buttermilk, or any dairy residue for reducing acidity in butter. Pien and Baisse [1936] have made a detailed study of the electrical de-acidification of milk. Lactic acid is not destroyed in electrolysis. In the presence of a protein, de-acidification results which may proceed as far as to render the solution alkaline. This is brought about by the electrolysis of sodium chloride of which sodium ion neutralises lactic acid and the protein is acted on with chlorine ion and had a blocking action on it. This is equivalent to neutralisation with alkali. Methods of electro-dialysis have been used by Woljogin and Scheimpflug [1936]. The case of acidity in ghee is, however, different as butter-fat is not miscible in water and colloidal matters are absent in it. In a electro-dialysis trial with cellophane as dialysing membrane the reduction in acidity with ghee was not very satisfactory. However, this is a line of promise for reducing acidity.

Ghee can be prepared from cream directly by heating the same and then separating the melted fat from the coagulated curd. This process can be used only for the sweet cream as in the case of the sour cream, the acidity will affect not only the taste and flavour but also the high acidity in ghee will seriously impair its vitamin and keeping quality. A sample of ghee prepared in this way gave an acidity in ghee 0·4 per cent. The flavour of ghee was poor and the vitamin content lower.

Butter can be melted into ghee in two ways. Firstly, it can be gently heated (temperature not to exceed 100° C.) and when the fat layer has separated and the curd layer has coagulated the fat layer can be carefully drawn out. Then it can be heated for ten to fifteen minutes at temperature not more than 110° C. to remove the adsorbed moisture and develop the ghee flavour. In this process the odour from the heated casein is missed. Secondly, the butter can be heated on a gentle fire till all the moisture is boiled off and the curd partially fried. This

is the process that is followed in India. In this way a rich aroma is developed in ghee which may take up a cooked smell as well. Even spices and curry leaves are some times added at the end of heating to enrich the flavour. However, most of the acid present in butter finds its way into ghee. An average sample of butter melted into ghee by the first process gave an acid value in ghee of 1·1 and by the second process 3·0.

The problem of storage of ghee and the effect of acidity on the same is important. On account of the tropical climate and temperature, butter is not stored in India but is melted into ghee. Even in the case of butter it cannot be stored satisfactorily at 0° C. but only at a temperature lower than —10 to —15° C. [McKay and Larsen, 1922]. Overman [1936] finds sweet cream butter to score higher and hold better in storage than butter made from the same cream after ripening with a starter and partial neutralisation. Davies [1936] finds butter from non-acid cream of low flavour to keep better than more highly flavoured butter from ripened cream. White *et al.* [1929, 1930] got similar results with butter of different acidity. Samples of butter and ghee were stored at 0° C. and at room temperature and the acidity after storage was determined. The results are given in Table I :—

TABLE I

Sample	Acidity on date of preparation. Acid value	Acidity after storage. Acid value	Days of storage	Temperature of storage
Jersey cow ghee I	0·79	0·82	36	0° C.
Jersey cow ghee II	0·97	0·99	32	0° C.
Jersey cow ghee III	0·78	0·80	23	0° C.
Sindhi cow ghee I	2·4	2·6	36	0° C.
Sindhi cow ghee II	2·3	2·5	32	0° C.
Sindhi cow ghee III	2·3	2·3	23	0° C.
Murrah buffalo ghee I	1·3	1·4	36	0° C.
Murrah buffalo ghee II	1·3	1·4	32	0° C.
Murrah buffalo ghee III	1·3	1·3	23	0° C.
Mixed buffalo butter stored as butter but acidity determined on melted ghee	3 ·27	0·27	45	0° C.
	4 2·27	22·9	9	23° to 28° C.
	5 6·66	17·31	5	23° to 28° C.
	6 3·46	16·27	3	23° to 28° C.
Ghee prepared by the curd process	9 0·54	0·98	15	23° to 28° C.
Ghee prepared from milk directly without souring.	0·51	0·92	4	23° to 28° C.

The rate of vitamin loss in ghee or butter due to acidity is retarded as the result of natural anti-oxidants notably carotin. The acidity increases on storage at room temperature as butter and therefore the vitamin A content was estimated

to find out the loss. Samples 4, 5 and 6 were assayed for their vitamin A content colorimetrically after 16, 12, and 10 days, respectively, of storage. Sample 4 had lost 50 per cent, sample 5 possessed very little, and sample 6 only traces of its original vitamin content.

In another experiment, buffalo, and cow ghee from the same cream but at different degrees of acid value were maintained at 90° C. for different lengths of time and the vitamin A loss estimated colorimetrically with antimony trichloride reagent. By maintaining at a higher temperature, the rate of loss was increased to shorten the period of the experiment. The results are given in Table II.

TABLE II

Sample	Acid value	Vitamin value in Blue units Time in hours 0	2	3	4	8	10	15
Murrah buffalo ghee . .	2·26	13		11			9	
Murrah buffalo ghee . .	2·07	13			7·7		6·6	trace.
Murrah buffalo ghee . .	4·0	13	8		5·5	*Nil*		
		0 hrs	10 hrs	15 hrs	20 hrs	25 hrs.	36 hrs.	
Kangian cow ghee	0·3	17	17	16	13	12	9	
		0 hrs.	4 hrs.	10 hrs.	15 hrs.	25 hrs.		
	1·6	17	14	13	4	*Nil*		
		Yellow carotin value in Yellow units						
		20 hrs.	27 hrs.	40 hrs.	50 hrs.	60 hrs	72 hrs.	
Kangian cow ghee . .	1·0	12	11	7·7	4·4	3	...	
	0·4	15	13	13	10	8	6	

DISCUSSION AND SUMMARY

While acidity is undesirable in butter or ghee, a good quality butter or ghee of rich aroma can only be prepared after proper souring of milk or cream. The temperature of souring and degree of acidity produced determine the quality of butter. Pasteurisation of cream, neutralisation of initial acidity, and the use of proper starter is desirable but the control of acidity is very important. An acidity of 0·44 per cent in the sour cream is the best all-round figure for practical purposes. It is better to have an under ripe than an over ripe cream for butter manufacture. Butter or ghee prepared directly from fresh milk is without flavour but of very good keeping quality. It can be used for reducing acidity of high acid ghee or butter. While washing removes buttermilk from butter, excessive washing will cause loss of flavour. Neutralisation of acidity, washing

with de-acidified milk products, electro-dialysis, and other processes are useful in reducing acidity. However, with a little care in the ordinary way an acid value of 0·3 can be obtained in the melted ghee. Such a sample of ghee keeps quite satisfactorily in storage. The indigenous method of ghee preparation by the curd process is not satisfactory. The yield of fat is poor and the starter culture is not properly selected. This is worse in summer months. Again the method of melting butter into ghee by evaporation, while it gives a richer aroma is positively harmful as it increases the acid value of ghee. Butter should not be held for any length of time except at a cold temperature, and only when its acidity is very low. It should be melted at once into ghee for storage and vitamin potency It is not easy to reduce the acidity of ghee so that the reduction of acidity should be attempted in the earlier stages of preparation rather than later. Acidity in butter or ghee at ordinary temperature increases the acidity and destroys the vitamin A content very quickly.

We take this opportunity to express our grateful thanks to the Imperial Dairy Expert, Bangalore, for kindly providing us with high acid cream and butter. The Hebbal Dairy Farm of the Department of Agriculture, Mysore, also helped us in carrying out most of the creamery operations at their place and for this our grateful thanks are due to them. Prof. Subrahmanyan of the Department of Biochemistry deserves special mention for his kind interest during the course of the experiment.

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MANURIAL EXPERIMENTS WITH SULPHATE OF AMMONIA AND NITRATE OF SODA ON SUGARCANE

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SULPHATE of ammonia and nitrate of soda are two important nitrogenous artificial fertilizers, widely used in the manuring of field crops. Nitrate of soda has a quicker effect on plant growth and is more beneficial to deep-rooted crops than sulphate of ammonia which is better suited for shallow-rooted crops [Fream, 1932].

A set of field experiments were carried out at Pusa (New Area) on a replication system with a view to studying the effects of the above two fertilizers on the tonnage yields of Co. 210 and Co 213 –the standard varieties of sugarcane in North Bihar. The soil of the New Area is not a good class of cane loam ; it is deficient in available phosphoric acid and nitrogen, but rich in lime and potash.

Experiment No. 1.—It was conducted during the year 1931-32 with two varieties of sugarcane—Co. 210 and Co. 213. The two treatments were (*i*) 164 lb. sulphate of ammonia (20·6 per cent nitrogen) per acre and (*ii*) 164 lb. nitrate of soda (15 per cent nitrogen) per acre The fertilizers were applied in one dose at the end of May, 1931.

Experiment No. 2.—This experiment was laid down during 1931-32 under Co. 210 and Co. 213. The two treatments were same as in the above experiment with the difference that the fertilizers were applied in two doses—half at the end of May and the remainder at the end of June, 1931, before the break of the monsoon.

Experiment No. 3.—It was also conducted during the year 1931-32 with Co. 210 and Co. 213. The two treatments were same as in the above experiments, and both the fertilizers were applied in one dose at the end of June, just before the break of the monsoon.

Experiment No. 4.—This experiment was conducted during the year 1932-33 with Co. 210. The treatments were (*i*) 80 lb. nitrogen per acre as sulphate of

ammonia and (*ii*) 80 lb. nitrogen per acre as nitrate of soda. The fertilizers were applied in two doses—half at the break of the monsoon (4th June, 1932) and the other half given one month later.

The results of these experiments may be summarized as below :—

1. Nitrate of soda gives slightly higher tonnage yield of sugarcane than sulphate of ammonia, but the differences are not statistically significant. In one of the experiments (No. 1), however, Co. 210 has shown a significantly higher yield with the treatment of nitrate of soda.

2. Application of nitrogenous fertilizers in two doses is more conducive to tonnage yield than the single dose. Further, manuring just before the break of the monsoon is more helpful to sugarcane than at other times in the year.

3. From the economic point of view, there is no difference between these fertilizers when applied on the basis of same bulk weight, but sulphate of ammonia is more profitable than nitrate of soda when used on an equal nitrogen basis.

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A SHORT HISTORY OF SUGARCANE CULTIVATION IN BIHAR UP TO THE MIDDLE OF THE 19TH CENTURY

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AMONG the many products of civilization that India has given to the world, the cultivation of sugarcane with the manufacture of sugar and allied products from its juice is perhaps one of the most important. The word ' sugar ' and its equivalents throughout the civilized world are derived from the Sanskrit word ' sarkara '. In his Dictionary of Economic Products of India, Sir George Watt has dealt with the history of sugarcane in great detail. After carefully considering the philological evidence he concludes, ' sarkara ' appears to have given origin not only to the Arabic, Persian, Greek and Latin classic names but to the extensive assortment of words in the modern languages of India and Europe which are very nearly the direct equivalents of the English word ' sugar '. Though there is some difference of opinion among the authorities in accepting India as the original home of the sugarcane, there can be no doubt that here alone it was first cultivated as a field crop of economic importance. And Bihar has always been perhaps the most important producer of cane-sugar and allied products all through history. Sir George took great pains to find out if there was any mention of sugarcane or of sugar in the early literature of the other two ancient and contemporary civilizations, namely, the Hebrew and the Chinese. He could find no mention of sugar in Hebrew, and it is first mentioned in the Chinese literature in the first century B. C. On the other hand, he found the early Sanskrit literature full of references to sugar. On a critical examination of the classic Sanskrit literature available at the time of his writing and of the records left by early European travellers he seems, however, to have had some doubt about its cultivation in India as a general field crop. Because he says, " It has to be admitted, however, that the earliest allusions in the classic literature of the Hindus to sweet substance are such that it is impossible to determine what is actually meant ". And again. " But in this connection, it may be added, that the early European writers who speak of Indian sugar deal with it as a product of certain palms. For the most part they visited the western and southern coast, so that it is probably safe to assume that sugarcane cultivation did not find a very prominent place in the agriculture of India until almost modern time ".

The results of recent researches, which unfortunately were not available to Sir George have brought to light evidence which goes to show as clearly as is possible under the circumstances, that sugarcane cultivation and the manufacture of most forms of sugar were as familiar in the 4th century B. C. to the cultivators of this province as they are today. Speaking of sugarcane, Ragozin in his book, Vedic India, says : " We find no trace of a time when the art of manufacturing molasses and sugar by boiling down and clarifying the saps was unknown in India ". Mukherjee, in his History of Indian Shipping, indicates that even during the pre-Mauryan period there is evidence which clearly shows that India supplied foreign countries with oil, brassware, a liquid preparation of the sugarcane, etc. But above all is the authoritative and clear evidence found in Koutilya's Arthasastra, said to have been compiled in the 4th century B. C. This marvellous book, recently discovered and translated by Dr. Shama Sastri, the genuineness of which seems to have been accepted by various authorities, contains numerous references to and directions for sugarcane cultivation, sugar manufacture and the use of sugar not only as human food, but also for cooking purposes, for distillation of liquor, and as food for elephants, horses and cattle. We find in Chapter XV under " The duties of the Superintendent of Store House ", the following passages : "............... extracting oil by employing shepherds and oil makers, and manufacture of sugar from the juice of sugarcane are termed *simhanika* ". " *Phanita*, jaggery, granulated sugar, and sugarcandy are termed *kshara* ". Under Superintendent of Agriculture, is given " Rice crops and the like are the best to grow ; vegetables are of intermediate nature, and sugarcane crop (*ikshu*) are the worst (*pratyavaran, i.e.*, very difficult to grow) ; they are subject to various evils and require much care and expenditure to reap." The Bihar cultivator knows how true this is even today. There are many references to the use of sugar for different purposes, as for example, one *pala* (one *pala* according to the weights and measures given in Chapter XIX, works out to a little more than an ounce) of sugar should be issued, along with other ingredients and spices, for cooking twenty *palas* of flesh, horses should get five *palas* of sugar each in their rations, bulls should get ten *palas* of sugar or jaggery. That there was a considerable amount of trade in sugarcane products is evident from the statement in Chapter XXII on regulation of toll-dues. It is seen here that a duty of four to five per cent used to be realised on sugar.

Mention has already been made of the confusion of palm and cane sugar in the writings of European travellers who visited India (western and southern coast) between the 13th and 16th centuries, which led Sir George Watt to doubt the existence of sugarcane as a cultivated crop in India. Yule and Burnell wrote : " It is possible, indeed, and not improbable that palm sugar is a much older product than that of cane ". In the Arthasastra, however, I failed to find any mention of liquor or sugar made out of palmyra palms or any palms. In the chapter on forest produce it is mentioned that palmyra palm yields leaves for writing but no mention is made of toddy or sugar. Under the chapter on Superintendence of

Liquor, details are given of the ingredients of different liquors, *e.g.*, '*medaka*' is made from rice, '*prasanna*' is made from flour (barley) '*asva*' is from sugar (*phanita*), '*kapisayana*' and '*harhuraka*' from grapes, '*madhuka*' from *mahua*. Even mango fruits were utilized to make liquor which was known as '*sahakarsura*.' But no mention is made of palm or any palm juice product. The conclusion is inevitable that this property of the palm tree was not known then, at least in this part of the country. It is thus clear that when the cultivation of sugarcane and manufacture of sugar was fairly general, the manufacture of palm sugar was not known and there is therefore no reason to confuse the two. It is extremely probable, however, that up to this time, *i.e.*, the 4th century B. C., the cultivation of sugarcane was confined to India and possibly to northern India only. The first period of the economic history of sugarcane may thus be taken to have ended with the invasion of India by Alexander in 327 B. C. when the knowledge of Indian products was thrown open to the outside world.

From this time there was more intercommunication between India and Syria, Arabia, Persia, Greece and Rome. Such intercommunication must have been considerably accelerated by the spread of Budhism in the neighbouring countries and islands by the missionaries of Emperor Asoka. Thus we find on page 40 of Warmington's "Commerce between the Roman Empire and India" that sugar was one of the many articles imported from India for use in Graeco-Roman medicine. Again at page 259 we read : "In certain products there was a partial secret ; thus Indian iron and steel were known by the Romans to be Indian, but were not found in India by them if the intermediaries (Arabians, Axumites, Palmyrenes, Parthians) could help it ; again lac, sugar *makir*, *ghi*, gingelly oil, all Indian, were found by the author of periplus in East African ports, were known by him to come from India, and yet he never found them there, though the first three products are ascribed wholly or partly to India by other writers also ". From the records of Western and Chinese travellers it appears that the knowledge and cultivation of cane was slowly spreading in all directions from India. By the seventh century A. D. the plant seems to have spread eastward to China, to the Malayan Archipelago, and to the tropical islands of the East Indies and westward to Syria, and to the lands bordering the Persian Gulf. But that the new countries had much to learn in the art of sugar manufacture is evident from the fact that the Chinese Emperor Taitsung (627—650 A. D.) sent an emissary to Magadha to learn the art of sugar manufacture. At about this period the Chinese and the Egyptians appear to have begun to take great interest in the cultivation of sugarcane and the manufacture of sugar. The period from the 3rd century B. C. to the 7th century A. D. may be taken as the second period in the history of sugarcane when its knowledge and use were made known throughout the world.

From the 8th century we find great development in sugarcane cultivation and manufacture of sugar in China and in the rapidly expanding Mohammadan

empires. Unmistakable reference is made to sugarcane as cultivated on the shores of the Persian Gulf in the ninth century. The crusaders found it in Syria. One of the historians of that remarkable period (circa 1108) says : " The crusaders found sweet honeyed reeds in great quantity, in the meadows about Tripoli, which reeds were called ' sucra '. Sanutus, who wrote in 1306, says that in the countries subject to the Sultan, sugarcane was produced in large quantities, and that it was likewise carried to Cyprus, Rhodes, Sicily and other places belonging to the Christians. Europe was thus indebted to the Saracens for the introduction of sugarcane cultivation. Refined sugar is recorded by the Chamberlain of Scotland to have sold then (1329) at about one ounce of standard silver by the pound. Marco Polo and other travellers in the 13th century and later found great quantities of sugar being produced in China. In fact, China improved on the process of refining sugar and produced a whiter and cleaner stuff which was brought to India and was called *chini* Similarly the Egyptians produced what is now known as *misri* (from Misar, *i.e*, Egypt) by a process of double crystallization. Thus while the methods of cultivation and manufacture remained in this country as they were in the time of Chanakaya, other countries improved on them and there is reason to believe, not only captured a large share of the export trade in this commodity but actually supplied India with *chini* and *misri*

By the beginning of the 15th century the European nations began to progress and, as in everything else, they began to take interest in sugarcane cultivation.

According to Sir George Watt, the Spaniards carried the cultivation and manufacture of sugarcane to the Canary islands in the fifteenth century, but prior to that (1420) the Portuguese had conveyed it from Sicily to Madeira and to St. Thomas' island. In 1506 it was taken from the Canary islands to San Domingo. The Dutch established sugar works in Brazil in 1580, but on being expelled from that country by the Portuguese, they carried the art of sugar manufacture (1655) to the West Indies. Sugar was manufactured by the English in Barbados in 1643 and in Jamaica in 1644. And within the next hundred years sugar plantations were well established in all the European colonies

I have gone into some detail in describing the spread of sugarcane cultivation in all suitable and unsuitable places of the old and new worlds with a view to show how Bihar fell from the position of perhaps the premier producer and supplier of sugar to the world to a position of only one unit out of so many. Moreover some of the colonial islands were found to be better suited to the cultivation of sugarcane than Bihar or Upper India in general. With a suitable climate and soil in the colonies, European enterprise, management and technical skill helped by rapidly developing science, and unfettered by uneconomic traditions, laws of inheritance, tenancy, and religious prejudice, soon brought about a revolution in the cultivation of cane and manufacture of sugar which left the indigenous industry of Bihar far

behind in point of efficiency. And the world began to look to these other places for its supply of sugar than to India.

The indigenous industry, however, struggled on to supply local requirements. Throughout the eighteenth century the history of sugarcane cultivation in Bihar is so confused that it is difficult to get a true perspective. The country was in a state of chaos, and agriculture, industry and trade declined. We find in 1776, the merchants of Calcutta memorialized the Government on the decline of sugar trade and consequent losses that had been sustained. "Even so late" the memorial explained, "as the period immediately preceding the capture of Calcutta, in 1756, the annual exportation was about 50,000 maunds, which yielded a profit of about 50 per cent."

About the end of the eighteenth century an attempt was made to establish the industry on European lines. These endeavours may be stated to have been due to the action of the Hon'ble East India Company who realized that there were possibilities in Indian sugar. Several plantations and factories were started by Europeans in Tirhut and a few in South Bihar. For a time the trade throve and it seemed as though the industry would revive. But the company failed to get from the British Government the same preferential treatment as was extended to the sugar planters of the West Indies. In the meanwhile indigo had become more profitable than sugar. Many of the sugar plantations and refineries were therefore converted into indigo concerns. Besides, the difficulties of transport and heavy freight charges left little profit in the sugar trade. The Hon'ble Company therefore ceased to take interest in sugar and in 1820 gave order that sugar should no longer form part of their commercial investments. The first attempt to establish the industry on a sound basis thus failed.

This failure led the Government to hold an enquiry respecting the means of improving the quality and reducing the cost of sugar production. This enquiry was held in 1824. It was thought then that there was little hope for large manufacturing concerns and small factories were recommended. In the absence of railways and consequent difficulty of transport large factories were certainly impossible in those days.

A unique opportunity soon offered itself to the sugarcane growers and sugar manufacturers of Bihar. With the emancipation of slave labour in 1838, the plantations in the West Indies were disorganised and many planters there sold their estates and began to come over to India. The heavy protective duty in favour of the colonies was also abolished by the British Government in 1836. In an article in the *Bihar and Orissa Agricultural Journal* Mr. C. S. Taylor, the then Agricultural Chemist of this province, says: "The great rush, however, did not take place until 1845, and there was no great amount of European machinery in Bihar before that date. In 1837, however, the question was discussed at a planters' meeting as to whether indigo should not be abandoned for sugar. This

appears to have been the second epoch in European sugar enterprise, but the matter seems to have been dropped until 1845 when the price of indigo had fallen to Rs. 110 per maund, and the Bihar planter turned to look for some more profitable crop, thinking he saw it at last in sugar ".

The export returns show this revival clearly. In 1836-37 the total quantity of sugar exported to Great Britain was about 2,60,000 cwt. but in 1840-41 it was 12,26,000 cwt. But the prosperity did not last very long. The whole thing came to a crash by about 1851. The history of the sugar industry during this period appears to be more or less analogous to the present boom, except in the fact that it then depended more on an export trade on 'fair field and no favour' basis, while the present one depends on the heavily protected home market. It is reported that about £1,000,000 were sunk in machinery in Bihar in that period. An analysis of the causes of this failure may therefore be of some interest at present, and I can do no better than quote from Mr. Taylor's article a most instructive description of it.

" Enormously good returns seem to have been obtained in the first place by the planting of Otaheite cane on the small scale in particularly good land, and calculating from the results they obtained, the experimenters were of opinion that rapid fortunes would be gained by cane growing. On their calculations they risked an enormous amount of capital in the importation and setting up of expensive machinery from England. The difficulties in their importation may easily be imagined when it is remembered that there were then no railways and that the whole of the journey from Calcutta into Bihar had then to be performed by river and road, both of which were frequently almost impassable. It appears that from £700,000 to £1,000,000 were sunk in machinery at this time ".

" All kinds of land were put into cane and no rotation of crops was followed In most cases no manure was applied, and owing to this, and attacks of disease, the yields fell from sixty to two and a half maunds per *bigha*. In addition to this, the sugar was, as a rule, boiled badly, and refused to granulate well. Owing to this fact, after travelling to Calcutta, the product became a sticky mass which sold for next to nothing."

" In face of all these difficulties those of the planters who had taken up sugar were rapidly brought nearly to ruin. Luckily for the planter, however, the price of indigo rose in 1849 and 1850 and sugar was rapidly abandoned for the more paying dye. A list given by Mr. Filgate, the Secretary of the Bihar Planters Association, names thirty-two distinct sugar concerns, each started between 1842 and 1850 and all closed down in 1850 or 1851. In 1849 an attempt appears to have been made by Mr. Robinson, a Mauritius sugar planter and engineer, to hold forth sugar planting in as glowing a light as possible, but his efforts do not seem to have met with success "

"This second epoch in European enterprise then came entirely to an end in the fifties. The failure of the attempt may be put down entirely to want of calculation in the first place, followed by want of system afterwards. The planter of that time was far too ready to jump to conclusions from insufficient data, or merely from hearsay, and the calculations made were based upon perfectly inaccurate premises."

It is probable, however, that the growers and manufacturers could have learnt from the mistakes they made and settled down to a solid basis on which a healthy industry might have grown, but for a most epoch-making discovery in the manufacture of sugar from beet. In 1747, Professor Marggraf of Germany discovered the existence of common sugar or sucrose in beet root. By 1840, beet-sugar industry in Europe, particularly in Germany, had grown into a national enterprise, and began to control the sugar market of the world. It forced the colonial sugar producers to reform their methods and cheapen the cost of production to the utmost, by all possible means that science and skill could devise. It was not possible for Indian growers to do the same because age-old customs and laws and many other factors stood in the way. The inevitable consequence was that the indigenous industry collapsed and the country had to depend more and more on foreign sugar. The exports declined and gradually vanished and imports increased.

ABSTRACTS

Cross-bred and grade dairy cattle in India. C. E. MACGUCKIN. (*Ind. J. Vet. Sci. & Anim. Husb.* 7, 263).

THE paper deals with the breeding of cross-bred and grade cattle in India, with special reference to the work done in this line by the Military Dairies. The anticipated yields—based on the theory of the intermediate index—and the actual yields—obtained by the Military Dairies—are given, and the reasons for the differences discussed.

The dangers of cross-breeding and grading without good foundation stock and good management are pointed out.

As the percentage of castings and deaths in a breed reflects also on its economic value, the percentage of castings for various reasons, and the percentage of deaths from various diseases, amongst the cross-bred, grade and indigenous cattle, belonging to the Military Dairies, have been compared. (*Author's abstract*)

The occurrence of Air-sac mite, *Cytoleichus nudus* (Vizioli 1870), in fowls in India. R. L. KAURA and S. GANAPATHY IYER. (*Ind. J. Vet. Sci. & Anim. Husb.* 7, 299).

THE occurrence of mites within the air-sacs of fowls is recorded, for the first time in India. Although primarily parasitic in these sites, an extensive infection of the organs had developed.

This mite is indistinguishable from *Cytoleichus nudus* (Vizioli 1870), popularly known as the Air-sac mite. On account of the difficulty in treating the affected fowls, it is considered to be a serious condition. (*Authors' abstract*)

A note on the method for determination of the calcium requirement of man. MD. ABDUL HYE. (*Ind. J. Vet. Sci. & Anim. Husb.* 7, 303).

IN a recent paper on the determination of calcium requirement of man by Dr. I. Leitch (*Nutrition Abstract and Reviews*, January 1937) the author has applied a new method to metabolism data; in which 397 normal subjects were divided into groups of negative and positive balances, based on the difference between intake and output of calcium. Two linear relations, separately with positive and negative balances were obtained from which the maintenance requirement of calcium was estimated.

No justification has been given for dividing these observations on normal individual into groups of positive and negative balances. Assuming the data to be normal, the present author thinks that it is desirable to pool all the data together (positive and negative) neglecting the inevitable chance fluctuations from individual to individual and obtain one straight line and estimate the maintenance requirement, as has been done by the present author for the estimation of minimum requirement of protein and other feed nutrients for maintenance of cattle. The value obtained in this way is 0·52 gram of calcium per day whereas Dr. Leitch's value is 0·55 gram. (*Author's abstract*)

Some observations on the incidence and inheritance of imperforate anus in Ganjam calves. P. S. KUPPUSWAMI. (*Ind. J. Vet. Sci. & Anim. Husb.* 7, 305).

THE incidence of imperforate anus is a rare anatomical abnormality among cattle ; its occurrence among calves has however been noted extensively in the Ganjam tract. It is said that the calves operated for this abnormality die a premature death. From the study of the abnormal cases appearing in first, second, third and fourth calvings of cows it is suggested that the character 'imperforate anus' is a recessive one. It is suspected that this abnormality may be associated with extra appendage of the skin found in some of the animals belonging to this tract. It is suggested that, for the elimination of this character from the Ganjam stock, a study of inheritance of this factor is necessary. (*Author's abstract*)

Congenital corneal dermoid in a calf. G. K. SHARMA. (*I. C. A. R. Misc. Bull.* No. 15, p. 1).

THE author reviews the literature on corneal dermoid in animals and presents an interesting clinical record of a case in a calf, in which the teratomatous growths were confined to both eyes covering the palpebral fissures and external eyes almost completely, and had all the histological features of skin.

The calf was born blind and with a very poor constitution. It had a bulldog mouth and the forelegs were deformed. It could neither suckle nor move freely and died after a week. (*Author's abstract*)

Peculiar nervous derangement in a fowl infected with Ranikhet disease virus. R. L. KAURA and S. GANAPATHY IYER. (*I. C. A. R. Misc. Bull.* No. 15, p. 3).

THIS paper records the symptoms of cerebrospinal affection in a fowl infected with Ranikhet (Doyle's) disease virus in a sub-acute form showing that the virus is of a neurotropic nature. The symptoms exhibited included partial paralysis of the

limbs and frequent upward and backward clonic spasmodic turning of the head and neck. On handling, the fowl displayed excitement culminating in a series of backward somersaults until it became exhausted and fell.

While a similar nervous condition may occur as a result of faulty nutrition, it was not so in this case as was determined by blood analysis, and by the fact that a well-balanced diet is fed to all experimental fowls at the Imperial Veterinary Research Institute, Mukteswar. (*Authors' abstract*)

Atrophic cirrhosis of the liver and ascites in a ram. G. K. SHARMA and G. S. KHAN. (*I. C. A. R. Misc. Bull.* No. 15, p. 9).

THE authors have recorded the composition of ascitic fluid extracted from an affected ram during the course of the disease.

The fluid was clear, watery and translucent having a specific gravity of 1·012 and the *p*H value of 7·6. The total solids were 20·31 per 1000 parts of the fluid, of which the organic matter was 11·80 and inorganic 8 51. Sodium, magnesium and traces of potassium were present as chlorides, sulphates and carbonates.

The subsequent post-mortem examination revealed atrophic cirrhosis of the liver due to *Fasciola hepaticum*. (*Authors' abstract*)

The annual cycle of the Desert Locust (*Schistocerca gregaria* **Forsk.**) **Its migrations and periodicity in Persia and Asia.** S. A. PREDTECHENSKY. (Lenin Academy of Agr. Sciences in U. S. S. R. Bulletin of Plant Protection. Ser. I. Entomology. No. 12. Leningrad. 1935).

THE provinces of Turkmenistan in Central Asia and Trans-Caucasia are regions subject to the invasions of the Desert Locust in Asiatic Russia, and although the insect is a comparatively rare visitor there, appearing only during outbreaks of extraordinary intensity, the fact that the swarms arrive quite suddenly, and moreover, appear in a state of full maturity, ready for oviposition, renders its attacks extremely dangerous to agriculture. The unexpectedness of its appearance, usually leaves little time for preparing for a campaign, so that the need for getting a timely warning from the countries from which the swarms arrive in the territories of the U. S. S. R. has been greatly felt. As no information is available in these countries in regard to the movements of the swarms, and as there is no organisation there for making the needed observations, the author—S. A. Predtechensky—was deputed for the investigation of the problem and studying the migrations of the Desert Locust in Iran.

The author toured almost the whole of Iran during the years 1929, 1930 and 1931, and by making personal observations and by collecting information on locust movements and locust damage from various sources, succeeded in amassing data of a very valuable nature in regard to the infestation of the Iranian area. When these data are studied along with those available in British Baluchistan and India

for the recent cycle of 1926-1931, it enables one to get a fairly complete picture of the activities of the Desert Locust in the Indo-Iranian region of infestation.

Predtechensky first describes the general configuration of the mountain regions of the vast territories of Iran and later correlates the details of the oro-relief with the climatic conditions of the country. One of the main characteristics of the Iranian area is the existence of a strip of lowland plain along the shores of the Persian Gulf and the Arabian Sea, which remains comparatively warm during the winter months and serves as an overwintering area for the swarms of Schistocerca. The greater part of Central and Western Iran forms an elevated plateau of varying altitude, traversed by the high ranges of the Western Iran Mountain Range, the Pusht-i-Koh hills, and the Zagros Mountains. The eastern part of Iran is to a large extent composed of great lowlying, inland plains,—Dasht-i-Lut, Dasht-i-Kavir, and the Seistan Basin,—surrounded by hilly areas, especially to the north, where the high hill-ranges of Kopet-Dagh and Aleh-Dagh separate northern Khorassan from the plains of Kara-Kum in the U. S. S. R. Climatically these basins form comparatively warm areas, offering a great contrast to the cold climate of the surrounding highlands and mountain ranges. The progress of the locust migrations is rapid across these basins or along their margins, while it is greatly delayed when the swarms get into the valleys of the mountain ranges.

The author then proceeds to give a detailed chronicle of all known locust data, compiled from available published records or collected from various sources by personal enquiries, for (1) Persia, 1901-1931, (2) the countries of Anterior Asia (or the Near East), such as Arabia, Iraq, Palestine, Turkey, etc., for 1926-1931, and (3) India, Baluchistan and Afghanistan for 1812-1931. In the light of his studies of the spread of infestation during the last great cycle of 1926-1931, the Asiatic area of incidence of the Desert Locust is, in his opinion, divisible into an Eastern and a Western part: the Western part being composed of the whole of the Anterior Asia inclusive of western Persia and Trans-Caucasia, and presumably connected with the Arabia-Sudan region of Locust habitat, and the Eastern of the rest of Persia, the southern part of Central Asia, Afghanistan, Baluchistan and North-West India, forming the Indo-Iranian region of infestation.

From a comparative study of the years of infestation in the past in the Asiatic area, it is evident that the periods of mass appearance have been occurring in cycles, on the average, once in 11 years. Though the length of the periods of infestation may vary in the different parts of the Asiatic area, there appears to be a general co-incidence in the time of their occurrence. According to the number of years in which the infestation had occurred during the cycle of 1926-31, the author divides the Iranian area into different regions, of which the south Iranian coastal area, in which locusts had been active all the six years, is the most important from the point of view of the development of the yearly infestation, since, evidently, the attack has gradually radiated into the other regions from this area with the advance of mass-multiplication.

Dealing with the factors regulating the annual cycle and periodicity of the Desert Locust, the author lays stress on the connection between periods of good rainfall and the time of mass-multiplication of the locust. In countries with summer drought like Persia, he opines that there should be only a single generation, unless the locusts

produced in Iran migrate to countries with summer rainfall. Since in north-west India it is known that two generations may, and in most years do, occur, the dynamics of the locust would appear to be governed by the occurrence of favourable rainfall in such countries. According to the author, Arabia is also a country in which two generations may normally occur, and is thus of equal importance in regard to the periodicity of the locust.

The following is considered by him to be the general scheme of the annual cycle of the locust in Persia and adjacent countries with only a single generation. The locust over winters in an immature state and attains sexual maturity only in February, egg-laying occurring as it migrates into the interior of the country. Hoppers are met with between March and June, while adults of the new generation begin to appear from April onwards, and are to be seen in the territory till January, unless they happen to migrate into neighbouring countries. In north-western India, and presumably also in southern Arabia, the development of two generations complicates matters, so that the adults of the first or spring generation begin to appear by April, and those of the second or summer brood by September.

The author divides the Asiatic region of habitat of the Desert Locust into 6 distinct bio-phenological zones, from the point of view of the time of occurrence of the locust and the occurrence of breeding therein

1. A zone of flights and partial overwintering of swarms in India, including Bihar, Bengal, Orissa, Assam, north Madras, and parts of Bombay and the Central Provinces.

2. A zone of perennial occurrence of locusts with a double breeding-period : (1) winter-spring, and (2) summer-autumn, including north-western India (Sind, the Punjab, Rajputana, etc.) parts of the North-West Frontier Province and United Provinces, eastern Mekran, as also southern Arabia.

3. A zone of perennial occurrence with a single winter-spring breeding period : Mekran, south Iranian Lowlands, parts of Iraq, Arabia, Palestine, etc., and the western parts of Baluchistan.

4. A zone of extended seasonal occurrence of swarms with a single early period of breeding : (February to December) : including Baluchistan, southern Afghanistan, the northern parts of south Iran, north Iraq, etc.

5. A zone of restricted seasonal occurrence of swarms with a single late period of development (April-September) : including northern parts of Afghanistan, the southern parts of north Iran, eastern Turkey, etc.

6. A zone of very short seasonal occurrence with a single very late period (May-August) including north-east Afghanistan, the southern parts of Central Asia, the northern parts of Iran, etc.

In the opinion of the author, it is the second of the above six zones that is of greatest importance with reference to the dynamics of the locust, since the increase in numbers leading to its mass-multiplication is dependent mostly on the development of the second or autumn generation.

While discussing the various factors affecting the movements of yellow locust swarms in spring, he observes that seasonal variations of temperature have a great influence not only on the time of commencement of the migrations, but also on their direction. Swarms usually overwinter in the southern coastal strip of Iran, and although a few flights do occur during the winter months, it is only with the rise of temperature in February that regular migration movements commence. Various observations made indicate that locust flights are possible only when the maximum daily temperature exceeds 20° C. Early in the morning, locusts are generally torpid, and it is only as the temperature rises and their bodies also get the benefit of insolation from the morning rays of the sun, that they become active and resume flight. As to Ballard's inferences regarding the influence of the prevalent winds on locust migrations in Egypt, the author is disposed to consider that, although the influence of wind on swarm migrations cannot be denied, wind by itself can hardly induce locusts to fly from one locality to another. He gives various instances wherein the inequalities of distribution of swarms noted by him in the spring months in north Persia were clearly due to differences of temperature conditions.

Besides the factor of temperature, the conditions of soil and vegetation in the areas subject to locust invasions also influence the course of swarm flights. In the dry regions which the locust usually infects, loss of body-water is a serious handicap, and the course taken by the migrations is therefore, naturally biassed considerably by the factor of the presence of vegetation and soil-moisture. In the case of the great bare deserts of Dasht-i-Lut and Dasht-i-Kavir and, to a certain extent, also the Seistan Desert, locusts rarely fly across them, but hug their fringes, where usually a certain amount of moisture is noticeable, due to the run-off from the mountain flanks adjoining the desert. On these vast deserts, breeding is observable only in such moist portions, while in the case of the smaller deserts like Kavir-i-Baijistan and Lurg-i-Shuturan, surrounded by hills and well-furnished with soil-moisture and vegetation, infestation may occur on an extensive scale all over the area.

The nature of oro-relief of the regions subject to locust invasions is another factor that profoundly influences not only the direction of the migrations but also the relative rapidity of the flights. The course of migrations generally follows the direction of the valleys, and wherever high ranges with cold climatic conditions cross the line of flight, the advance of the swarms is either checked or deflected to either side of the ranges. The importance of long, deep valleys, and of the fringes of extensive low-lying deserts in functioning as routes along which the most rapid advance of the yellow swarms to the north occurs in Persia, is, in the opinion of the author, clearly proved by comparing the dates of first appearance of the swarms at various localities situated in the same latitude but at different altitudes, since swarms appeared very much earlier along the flight routes than in the interior of the mountain uplands with a cold climate.

As a result of the operation of the above factors, the author distinguishes four main definite flight routes in Iran, along which extremely rapid progressive movements of organized masses of the yellow locust in spring take place.

1. *The Hari-Rud Route.*—Proceeding from Baluchistan, *viz.*, the borders of Seistan and the Khaf Basin, to the Hari-Rud valley, this route opens into the Kara-Kum plain along the courses of the Tedjen and the Murghab.

2. *The Sabzawar Route.*—From Baluchistan, this route runs along the fringes of the Dasht-i-Lut and the Dasht-i-Kavir to the Sabzawar region, and thence passes across the Jaghatai and the Kopet-Dagh ranges into the Kara-Kum plain.

3. *The Semnan Route.*—Branching from the Sabzawar route near Tabbas, this route bends round the Dasht-i-Kavir desert towards the west and leads into the Elburze Mountain valleys.

4. *The Urmia Route.*—Entering the south-western borders of Persia from the west, this route passes along the valleys of the Western Iran Range into the basin of the Urmia lake and thence enters the limits of Trans-Caucasia.

As to the source of the yellow locust swarms found migrating in spring into Iran, the author considers that the numbers found overwintering in the south Persian lowlands are too few to account for the huge masses of locusts that pass across Iran. Quite a large proportion is derivable from the Arabian area flying across the Hormuz Strait from the Oman Peninsula or coming from the direction of Najd across south-east Iraq, and possibly also from the Indian area *via* British Mekran.

A study of the movements of the yellow locusts in Persia during the year 1927-1931 shows that the distribution and the extent of the infestation in Persia during the different years depended greatly on (1) the geographical position of the over-wintering swarms in winter, and (2) the particular routes followed by the invading swarms. For 1926 no information is available except that only southern Persia was affected. In 1927, the eastern parts of Persia up to central Khorasan were covered by swarms invading from southern Persia. In 1928, the infestation reached up to the Russian borders along the east, and in addition, the western parts of Persia were also invaded by swarms coming from Arabia, *via* Iraq. In 1929, western Iran was free from swarms, but the rest of the country (central and eastern Iran) was severely affected and the flights penetrated far into Central Asia. In 1930, western Iran was severely affected, and the infestation penetrated into Trans-Caucasia, but along the east, the swarms reached only up to central Khorassan. In 1931, there was no over-wintering in the coastal regions of southern Iran as in previous years, and the swarms which appeared at the beginning of April from the Arabian area covered only the south-eastern and the south-western parts of the country.

The observations of the author show that scattered individuals of the yellow locust might be found far beyond the northern limits of swarm migrations, the flights being accomplished in a dispersed condition as solitary individuals.

By a study of the relative progress made by the swarms at various points of Persia within the same period of time in different years, the author has determined the influence exerted by the different flight routes on the rapidity of the northward advance of the swarms.

A comparative study of the movements of swarms and the areas covered by them in 1929 and 1930, has enabled the author to correlate the regions occupied by the invading swarms with the functioning of particular flight routes. Thus, it was ascertained that only Hari-Rud and Sabzawar routes had functioned in 1927, while in 1928, the Urmia route had functioned in addition. In 1929, Hari-Rud, Sabzawar and Semnan routes had been followed by the swarms, but not the Urmia route, while

in 1930, Sabzawar, Semnan and Urmia routes had functioned, but not the Hari-Rud one. In 1931, owing to the lateness of the migration, the distance covered by the northern advance was comparatively small, but migration had progressed along the Urmia, Sabzawar and Hari-Rud routes.

The Urmia route is dependent on the entry of swarms from Jajd or central Arabia *via* Iraq, while the swarms of the three eastern routes originate from concentrations overwintering in the south Persian lowlands. The latter are, however, ultimately traceable to swarms from the Oman Peninsula or to those entering east Persia from the Indian areas of hibernation. In the opinion of the author, the swarms of the Hari-Rud route are mostly drawn from the Indian area, and its non-functioning in certain years is, probably, to be attributed to the absence of movements from the Indian areas.

From the point of view of Central Asian infestation, it is important to determine the factors that serve to limit the northward advance of the migrations. According to the author, the following three are of great importance in this connection : (1) the geographical position and the northern limits of the overwintering areas. (2) the number and size of the yellow locust swarms advancing along a particular route, and (3) the meteorological conditions during the migration period.

(1) In 1929, concentrations of overwintering swarms extended up to the most northerly limits in the eastern part of the south Persian lowlands and therefore led to a very heavy invasion of eastern Persia, while in 1930, they extended also along the western parts of the area and caused the invasion of western Persia. In 1931, no concentrations were seen in south Persia in the winter of 1930-31, and the migration was late as well as comparatively limited.

(2) Observations on the spread of the swarms in Persia during 1929, 1930 and 1931 clearly demonstrate that the larger the number and size of the swarms advancing along any particular flight route, the greater will be the chances of their continuing in the gregarious state along a longer stretch of the route, and thus of the northern limits of their flight reaching farther from the starting point.

(3) A study of the conditions of temperature and moisture along the migration routes of the locust in Persia in 1929 and 1930 shows that the rapidity of the advance of the swarms is very greatly affected by them. For example temperature conditions in spring were higher in 1929 than in 1930, and led, to a more rapid and earlier advance in 1929 than in 1930, and in the latter year even the lower hill-ranges formed effective barriers to their further advance on account of the low temperatures prevailing therein.

By making a calculation of the distances covered by the advance of the yellow locust swarms in Persia during the spring months along the different flight routes in 1929 and 1930, the author concludes that over the plains and along valleys running meridionally, the daily rate of advance is about 10 to 13·3 k.m., while over nilly country the daily speed-rate may average 5 k.m. or even less.

With reference to the migrations of the immature or pink locusts, the author remarks that the data available are not adequate for coming to any definite conclusions. Pink locusts generally begin to migrate within 6 to 9 days of the mass transformation of hoppers at the places of hatching. Observations made show that the migrations of the pink locusts are directed, as in the case of the yellow locusts, towards the north

in general, but from the end of June, there is a general change to a southern, south-eastern or south-western direction. In summer, the swarms were observed to take to the air towards the evening and to continue their flight through a good part of the night. According to the author, swarms of pink locusts are probably capable of flying longer distances at a stretch and also of flying more rapidly.

Adverting to the question of the permanent breeding grounds of the locust, he considers it a matter of urgent importance to detect and delimit these areas, since they serve as the places of formation of the first swarms at the outset of the periods of mass development, as evidenced by Johnston's actual observations on the development of incipient swarms during the winter of 1925-26. An accurate knowledge of such foci is absolutely necessary for forecasting the appearance of swarms and for organizing preventive measures. The coastal areas of southern Iran are, in his opinion, quite likely to contain locust breeding grounds, since such foci have been found in similar country along the coast of British Baluchistan where they have been located in sandy areas covered with scrub vegetation known as "reks". The author states that he has also observed some rek-like areas along the Iranian coasts of the Persian Gulf up to Bushire, and likewise noted the presence of solitary locusts among the vegetation. He considers that such foci are likely to be found also in the southern parts of Arabia, and that an investigation of this subject is of importance to all countries of south-western Asia that derive their locust swarms from Arabia or India.

Summarising all the observations made by him, the author concludes that. in attempting to make an approximate forecast of the range of spring flights of the mature locusts in Persia and U. S. S. R., it is necessary to ascertain beforehand the location and extent of the overwintering swarms during winter, and the direction of their flights before the period of their northern migration, A more exact prognosis of the range of their flights and the extent of infestation would be possible only at the commencement of the period of northern migration, when one could have definite information about (*a*) the routes along which the swarms would be flying, (*b*) the time taken for the arrival of the foremost swarms at different stations along the migration route, and (c) the approximate size of swarms advancing along particular routes.

During the winter of 1 30-31, the author essayed a trial forecast of the migrations of the yellow locust in Iran in 1931, after making a full investigation in regard to the various points mentioned above. From the circumstances that no overwintering swarms were observable in southern Persia and that only limited numbe s of swarms arrived as late as the beginning of April, both in Iraq and Iran from Arabia, he made an estimate of the approximate distance that could be covered by the advancing swarms in Iran and predicted that they would not by any means be able to reach the borders of the U S. S. R. during 1931—a forecast which proved to be correct.

For the purpose of forecasting the range of flight and the regions of infestation in U. S. S. R. territories, the author considers it necessary to establish, during periods of mass-multiplication, a series of stations in Persia along the important flight routes for obtaining requisite data on the migrations of the locust during March, April and May. He also deems it very important that, in the interests of Afghanistan, Iran, and U. S. S. R., the northernmost breeding grounds of Schistocerca should be kept under regular observation, so as to make it possible to detect the formation of incipient swarms and to arrange for their prompt destruction, to prevent the development

of larger swarms. In view of the great danger to agriculture in various contiguous countries of south-west Asia, he advocates the formation of an international organization in Asia for locust control, and pleads for the continuance of research work on locusts of the solitary phase even during periods of disappearance of swarms (Y. R. R).

THE following abstracts of articles from the *Indian Forester* have been received from the President, Forest Research Institute, Dehra Dun, and are published here as they are of interest to agricultural workers :—

Effect of forests on erosion, floods, climate and rainfall and on irrigation experiments. W. D. M. WARREN. (*Ind. For.* LXII (7) : 4 plates. Pp. 414-17. 1936.)

THE seriousness of erosion in Bihar is described, and the necessity for obtaining control of the forests belonging to private owners at the headwaters of the drainage areas mentioned. The effect of contour trenching in improving forest growth and atmospheric humidity by holding up water is mentioned. (*M. V. Laurie*).

Punjab Erosion Conference. R. M. GORRIE. (*Ind. For.* LXII (11) : Pp. 673-76. 1936.)

DISCUSSES the districts in which erosion is serious, results of efforts at control up to date and proposals for the future. (*M. V. Laurie*).

Note on soil erosion in the Punjab. R. M. GORRIE. (*Ind. For.* LXIII (2) : Pp. 67-73. 1937.)

DESCRIBES the extent of erosion in the different districts of the Punjab giving data for run-off and erosion intensity. Results of past counter-erosion measures are mentioned and a summary of the main lines for attacking the problem in the future is given. (*M. V. Laurie*).

The irrigation of dry hill sal areas. W. D. M. WARREN. (*Ind. For.* LXIII (4) : Pp. 222-27. Plate 1. 1937.)

THIS article continues the discussion started in the *Indian Forester* in August 1935 and July 1936. The Scheme begun in 1933 arrests the run-off of water from hillsides by contour channels. The water then percolates down through the soil instead of running to waste. The delayed run-off on an extensive scale would be a solution for flood problems allowing the plain's water to get away first.

Remarkable growth is being experienced where formerly hollow and stagheaded drought-stricken trees prevailed. The density of the stocking is also increasing. Blank areas many years old are filling up with regeneration.

The cost is low, only Rs. 100 per mile, if dry rubble bunds for crossing nullahs are made.

The temperature at night in April (height 1,250 feet) under steady meteorological conditions was equivalent to that experienced at 3,000 feet in these parts.

Humidity and rainfall in May, under disturbed atmospheric conditions were higher than at any recording station nearby though its situation and topography were less favourable than at one station. Clouds in the latter half of this month were attracted each evening to the areas, with the often purely local precipitation of rain. Additional light showers in the day fell only in the area itself, and not outside, and so were not recorded. (*W. D. M. Warren*).

Erosion survey of the Uhl Valley. R. M. GORRIE. (*Ind. For.* LXIII (4): Pp. 218-22. Plate 1. 1937.)

A METHOD of recording and classifying the various vegetative and edaphic factors in an erosion survey is described. (*M. V. Laurie*).

Soil amelioration. L. R. SABHARWAL. (*Ind. For.* LXIII (4): Pp. 197-98. 1937.)

THE primary necessity of establishing a suitable vegetative cover on the ground to control erosion in preference to embarking on expensive engineering projects is emphasized. (*M. V. Laurie*).

Forests and climate. C. G. TREVOR. (*Ind. For.* LXIII (8): Pp. 505-11. 1937.)

THE influence of forests upon climate has been a controversial subject for many years. The physiological and physical processes attendant upon plant growth reduce the temperature of the air and the soil. By diminishing the velocity of winds forests decrease evaporation and wind erosion and afford protection to lands and buildings. But no reliable evidence can be found to supply the supposed influence of forests in increasing the total rainfall of a country. Forests increase relative humidity, conserve the supply of water for natural springs and reservoirs and regulate the flow of streams and rivers. Climate being a combination of all the above factors is naturally influenced by the presence or absence of forests. (*M. V. Laurie*).

Reclamation in the Pabbi Hills, Gujrat District, Punjab. R. M. GORRIE. (*Ind. For.* LXIII (5): Pp. 285-96. Plates 5. 1937.)

THE Pabbi Hills are a deeply eroded line of low foothills in the north-west corner of Gujrat District, Punjab, with arid conditions and a precarious rainfall of a few heavy thunderstorms each monsoon. The range is 30 miles long and exhibits all stages of grazing damage between long-continued closure and persistent overgrazing. The run-off in terms of maximum peak flood has been measured by the Irrigation

Branch during the last 30 years for a great many individual torrents, and the records thus obtained have been correlated with catchment conditions. The results show clearly the value of constructive counter-erosion work to supplement passive protection against grazing.

An historical account is given of the reclamation work which has been carried on intermittently since 1877 and is now effectively controlling run-off over 3,000 acres. Suggestions for future work include stricter grazing control over the whole 'reserved forest', land acquisition and eviction of graziers from land not yet reserved, 'gully plugging' in torrent headwaters to reduce flood peaks, improvement of natural grass crops by contour trenching and afforestation with *Prosopis glandulosa* and *Acacia modesta*; also improvement of farm cultivation by stream training and contour terracing. (*R. M. Gorrie*).

NEW BOOKS

On Agriculture and Allied Subjects

Principles and Methods of Tree-Ring Analysis. By Waldo S. Glock, with a Foreward by A. E. Douglass and a contribution by G. A. Pearson. (Carnegie Institution of Washington, Washington D. C.). Price $2.00.

Introduction to Plant Pathology. By Frederick Deforest Heald. 579 pages. 200 illustrations. (McGraw-Hill Publishing Co., Ltd., Aldwych, London, W.C. 2). Price 24*s*. net.

Some Canadian Wild Flowers—being the first part of "Wild Flowers of the Great Dominions". By the Lady Rockley (with seven page-plates in colour). (MacMillan and Co., Ltd., London, W.C. 2). Price 6*s*. net.

The Birds of America. By John James Audubon. (With an introduction and descriptive text for each plate by William Vogt, Editor of 'Bird Lore'). (MacMillan and Co., Ltd., London, W.C. 2). Price 42*s*. net.

The New Chemistry. By E. N. Da C. Andrade. Illustrated. (G. Bell and Sons, Ltd., York House, Portugal St., London, W.C. 2). Price 3*s*. 6*d*. net.

Prelude to Chemistry—an Outline of Alchemy; its Literature and Relationships. By John Read. With over 100 illustrations. (G. Bell and Sons, Ltd., York House, Portugal St., London, W.C. 2). Price 12*s*. 6*d*. net.

Lecture Experiments in Chemistry. By G. Fowles. 580 pages. (G. Bell and Sons, Ltd., York House, Portugal St., London, W.C. 2). Price 16*s*. net.

Evolution and its Modern Critics. By A. Morley Davies. (Thomas Murby and Co., 1, Fleet Lane, London, E.C. 4). Price 7*s*. 6*d*. net.

An Introduction to Geology. By A. E. Trueman. (Thomas Murby and Co., 1, Fleet Lane, London, E.C. 4). Probable price 4*s*. net.

The Cycle of Weathering. By B. B. Polynov. Translated by Dr. A. Muir. (Thomas Murby and Co., 1, Fleet Lane, London, E.C. 4). Price 10*s*. 6*d*. net.

Soils of the Lusitano-iberian Peninsula. By E. H. Del Villar. (Thomas Murby and Co., 1, Fleet Lane, London, E.C. 4). Price 40*s*.

Agricultural Analysis: A Handbook of Methods excluding those for Soils. By C. H. Wright. (Thomas Murby and Co., 1, Fleet Lane, London, E.C. 4). Probable price 12*s*. 6*d*. net.

An Index to the Genera and Species of the Diatomaceae and their Synonyms (1816-1932). Compiled by Frederick Wm. Mills. (Now complete in 21 parts. 1,726 pages reproduced by typed stencils). (Wheldon and Wesley, Ltd., 2, 3 and 4, Arthur Street, New Oxford Street, London, W.C. 2). Price £10 10*s*.

Biological Laboratory Technique. An Introduction to Research in Embryology, Cytology and Histology. By J. Bronte Gatenby. 8 illustrations. (J. and A. Churchill, Ltd., 104, Gloucester Place, London, W. 1). Price 7*s*. 6*d*.

A Textbook of Botany for Medical Pharmaceutical and other Students. By James Small. (J. and A. Churchill, Ltd., 104 Gloucester Place, London, W. 1). Price 21*s*.

The Alloys of Iron and Chromium. Vol. I. Low Chromium Alloys. By A. B. Kinzel and Walter Crafts. 535 pages. 186 illustrations. (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C. 2). Price 36 *s*. net.

Milk Products. By Harvey (Wm. Clunie.) Pp. VIII+387. With 73 illustrations. (London : H. K. Lewis and Co., Ltd., 1937). Price 16*s*.

Comparative Anatomy. By Neal and Rand. (P. Blakiston's Son & Co., Inc., 1012, Walnut Street, Philadelphia, PA. 1936). Price $4.75.

Biological Standardisation. By J. H. Burn. (London : Humphrey Milford, Oxford University Press, 1937). Price 21*s*.

The Physiology of Domestic Animals. By H. H. Dukes. (Bailliere, Tindall and Cox, London, W.C. 2). Price 27*s*. 6*d*.

Principles of Medical Statistics. By A. Bradford Hill. (The Lancet, Ltd., 7 Adam Street, Adelphi, London, W.C. 2). Price 6*s*. net.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

PLANT Quarantine Regulations and Import Restrictions relating to the following countries have been received in the Imperial Council of Agricultural Research. Those interested are advised to apply to the Secretary, Imperial Council of Agricultural Research for full particulars.

1. Memorandum on the legislative position in regard to plant imports into Kenya as at 31st October 1937.

2. Plant Protection Decree of Protectorate of Zanzibar, 1937 (No. 9 of 1937).

Summaries prepared by the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine, of:—

Plant Quarantine Import Restrictions of—

(1) the Republic of France.
(2) the Colony of St. Vincent (British West Indies).
(3) the Kingdom of Sweden.
(4) the Colony of Gambia.
(5) the Republic of Haiti.
(6) the British Colony of Bermuda.
(7) the Colony of Barbados (British West Indies).
(8) the Republic of Finland.
(9) the French Zone of Morocco.
(10) the Colony of St. Lucia (British West Indies).
(11) Cuba.
(12) French Colonies.
(13) the Kingdom of Norway.

14. Importation of Vinifera grapes and certain other deciduous fruits subject to in-transit sterilization authorised. (United States Department of Agriculture).

15. Importation and inter-state movement of frozen pack-fruits and sterilization of imported vinifera grapes by refrigeration (United States Department of Agriculture).

16. Service and Regulatory Announcements of United States Department of Agriculture, April-June 1937.

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Notification No. D.-3324-A37, dated the 6th January 1938, issued by the Government of India, Department of Education, Health and Lands.

In exercise of the powers conferred by sub-section (*1*) of Section 3 of the Destructive Insects and Pests Act, 1914 (II of 1914) the Central Government is pleased to direct that the following further amendment shall be made in the First Schedule appended to the Notification of the Government of India in the Department of Education, Health and Lands, No. F. 320/35-A., dated the 20th July 1936, namely :—

In columns 2 and 3 of the said Schedule—

(1) against paragraph 6 (*b*) after the entry relating to "Hungary",

(2) against paragraph 8 after the entry relating to "Southern Rhodesia" and

(3) to the entries relating to paragraphs 7 and 9 the following shall be added, namely :—

"Burma . Mr. L. P. Khanna, M.Sc., Assistant Lecturer in Biology, University College, Rangoon."

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

THE names of the following recipients of New Year Honours will be of interest to the Agricultural and Veterinary Departments in India :—

O.B.E. . . .	MR. RAM CHANDRA SRIVASTAVA, Director, Imperial Institute of Sugar Technology, Cawnpore. United Provinces.
Diwan Bahadur .	RAO BAHADUR DHANVADA ANANDA RAO, Director of Agriculture (Retired), Madras. Madras Presidency.
Rao Bahadur . .	MR. VISHNU RAMCHANDRA PHADKE, G.B.V.C., J.P., Principal, Bombay Veterinary College, and officiating Director of Veterinary Services, Bombay Presidency.
Khan Sahib . .	KHAWAJA KARAM ELAHI, Provincial Veterinary Service, Class I, Professor of Parasitology, Punjab Veterinary College, Lahore, Punjab.
Rai Sahib . .	MR. KASHI RAM, Assistant Economic Botanist, Imperial Agricultural Research Institute, New Delhi.
RAO SAHIB . .	MR. GORDHANRAM PARBHURAM PATHAK, B.Ag. (Bombay Agricultural Service), Cotton Superintendent, Gujarat, Surat, Bombay Presidency.
	MR. PALAMCOTTAH SUBBIAH VISHWANATHAN, Agricultural Engineer to Government Cawnpore, United Provinces.

Imperial Council of Agricultural Research

MR. R. SCHERER has been elected by the Associated Chambers of Commerce of India as their representative on the Imperial Council of Agricultural Research and on its Governing Body, *vice* SIR JOSEPH KAY, resigned.

RAO BAHADUR M. VAIDYANATHAN, M.A., L.T., F.S.S., Statistician, Imperial Council of Agricultural Research, on return from leave *ex*-India, resumed charge of his duties on the 18th December 1937.

Indian Central Cotton Committee

RAO SAHEB K. I. THADANI, Director of Agriculture, Sind, and KHAN SAHEB FARRUKHBEG SADIKALI BEG MIRZA having resigned the membership of the Indian Central Cotton Committee, the Central Government have been pleased to nominate :—

1. RAO SAHEB K. I. THADANI, to be a member of the Indian Central Cotton Committee to represent the Agricultural Department, Sind.
2. MR. ROGER THOMAS, Zamindar, Tharparkar district, Mirpurkhas, to be a member of the Indian Central Cotton Committee to represent the cotton growing industry in Sind.

The Governor-General in Council has been pleased to appoint SARDAR RAO BAHADUR BHIMBHAI RANCHODJI NAIK to be a member of that Committee for one year from 1st April 1937, to represent the cotton growing industry of Bombay.

Imperial Agricultural Research Institute

DR. G. W. PADWICK, M.Sc., Ph.D., D.I.C. who landed in Bombay on the 8th November 1937, has been appointed Imperial Mycologist, Imperial Agricultural Research Institute, in General Central Service, Class I, and assumed charge of his duties in New Delhi on the 15th November 1937.

Imperial Veterinary Research Institute

The services of MR. T. J. HURLEY, M.R.C.V.S., D.V.S.M., I.V.S., officiating Veterinary Research Officer in-charge of the Pathological Section, Imperial Veterinary Research Institute, are replaced at the disposal of the Government of Madras, from the 11th November 1937.

MR. M. Y. MANGRULKAR, M.R.C.V.S., Assistant Pathologist, Imperial Veterinary Research Institute, Mukteswar, has been appointed to officiate as Veterinary Research Officer in-charge of the Pathological Section in addition to his own duties, with effect from the 11th November 1937.

DR. PURNENDU SEN, M.Sc., Ph.D., Entomologist, Public Health Department, Bengal, has been appointed as officiating Entomologist, Imperial Veterinary Research Institute, Mukteswar, with effect from the 1st December 1937, *vice* MR. S. K. SEN, granted leave.

Madras

MR. T. BHUDAVIDEYA RAO NAYUDU, L.Ag., Deputy Director of Agriculture, II Circle, on transfer, has been granted a further extension of leave on average pay by one month from the 4th October 1937.

MR. T. J. HURLEY, M.R.C.V.S., D.V.S.M., I.V.S., on reversion from the Imperial Veterinary Research Institute, Mukteswar, has been appointed Principal, Madras Veterinary College.

RAO SAHIB K. KAILASAM AYYAR, G.B.V.C., Acting Principal, Madras Veterinary College, has been appointed Superintendent, Serum Institute, Madras.

MR. A. K. MITRA, M.R.C.V.S., Acting District Veterinary Officer, Madras, has been appointed as Lecturer in Surgery, Madras Veterinary College, *vice* MR. K. S. NAIR, G.B.V.C., M.R.C.V.S., granted leave out of India.

Bombay

MR. E. J. BRUEN, on return from leave, has been appointed Livestock Expert to Government, Bombay.

MR. B. S. PATEL, N.D.D., N.D.A., C.D.A.D., officiating Livestock Expert to Government, Bombay, on relief by Mr. E. J. Bruen, has been appointed to be Deputy Director of Agriculture, South Central Division, *vice* MR. V. V. GADGIL, reverted.

DR. J. K. BASU, Soil Physicist, Sugarcane Research Scheme for Deccan, Padegaon, was granted leave for 25 days, with effect from the 3rd January 1938 with permission to prefix to it the Christmas holidays from 26th December 1937 to 2nd January 1938.

Bengal

MR. GOSTA BEHARI PAL, M.Sc., officiating Agricultural Chemist, has been confirmed as Agricultural Chemist in the Bengal Higher Agricultural Service, with effect from the 5th October 1937.

United Provinces

MR. J. H. RITCHIE, I.A.S., has been granted leave out of India on half average pay for 10 months and 17 days in continuation of the leave already granted to him.

MR. P. B. RICHARDS, I.A.S., Entomologist to Government, United Provinces, continues to officiate as Director of Agriculture, United Provinces, *vice* MR. RITCHIE.

MR. SHRI KRISHNA DUTTA PALLIWAL, M.L.A. (Central), has been appointed to be Honorary Rural Development Officer, United Provinces with effect from the 10th November 1937.

Punjab

MR. DARSHAN SINGH, I.A.S., Deputy Director of Agriculture, Gurdaspur has been granted leave on average pay for two months and five days with effect from the 19th October 1937, with permission to affix the holidays from the 24th December 1937 to 2nd January 1938 to the leave.

MR. CHARAN SINGH, in charge of the duties of the Deputy Director of Agriculture, Multan, has been appointed Deputy Director of Agriculture, Multan in the Punjab Agricultural Service, Class I (permanent substantive), with effect from the 23rd November 1936, *vice* SARDAR SAHIB KHARAK SINGH, M.A., I.A.S., retired.

MR. H. G. SADIK, B.A. (Oxon.), Extra Assistant Director of Agriculture, Jullundur, has on return from leave been appointed in charge of the duties of Deputy Director of Agriculture, Gurdaspur, with effect from the 19th October 1937.

SARDAR SAHIB LABH SINGH, L.Ag., B.Sc.Ag., Associate Professor of Agriculture and in charge of the duties of Professor of Agriculture, Punjab Agricultural College, Lyallpur, in the Punjab Agricultural Service, Class I, has been appointed Professor of Agriculture, Punjab Agricultural College, Lyallpur, with effect from the 11th February 1937.

KHAN SAHIB CH. ALI MOHAMMAD, L.Ag., M.Sc. (Agri.), Oilseed Botanist, Lyallpur, has been appointed in charge of the duties of the Cerealist, Lyallpur, with effect from the 6th October 1937, in addition to his own duties.

On return from leave, DR. DALIP SINGH, M.Sc., Ph.D., has resumed charge of the post of Second Agricultural Chemist, Lyallpur, with effect from the 27th September 1937.

DR. S. V. DESAI, B.Sc., Ph.D., D.I.C., on return from leave resumed charge of the post of the Agricultural Bacteriologist, Lyallpur, with effect from the 3rd October 1937.

MR. A. C. AGGARWALA, B.Sc. (Hon.), M.R.C.V.S., assumed charge of the post of Professor of Animal Husbandry, Punjab Veterinary College, Lahore, with effect from the 16th September 1937.

MR. S. M. SARWAR, M.R.C.V.S., P.V.S. (Class I), Disease Investigation Officer, Punjab, under the Imperial Council of Agricultural Research, has been appointed Officer in-charge of the duties of the post of Professor of Medicine, Punjab Veterinary College, Lahore, with effect from the 16th September 1937.

MR. WALI MOHAMMAD KHAN, B.Sc. (Hons.), M.R.C.V.S., has been appointed Disease Investigation Officer, Punjab, under the Imperial Council of Agricultural

Research, with effect from the 16th September 1937 *vice* MR. S. M. SARWAR, M.R.C.V.S., who has reverted to the Civil Veterinary Department, Punjab.

MR. P. R. S. KRISHNA IYER, Assistant Veterinary Research Officer, Imperial Veterinary Research Institute, Mukteswar, has been appointed as officiating Professor of Pathology at the Punjab Veterinary College, Lahore, with effect from the 18th September 1937, relieving MR. KARAM ELLAHI, G.B.V.C., Professor of Parasitology, of the additional charge.

Central Provinces and Berar

MR. E. A. H. CHURCHILL, B.Sc., on return from leave, has been reposted as Principal, Agricultural College, Nagpur.

MR. S. G. MUTKEKAR, Deputy Director of Agriculture, on return from leave, has been reposted to the Western Circle, Amraoti.

MR. P. D. NAIR, officiating Deputy Director of Agriculture, Western Circle, on relief by MR. S. G. MUTKEKAR, has been transferred in the same capacity to the Northern Circle, Jubbulpore.

MR. GOVIND PRASAD, officiating Deputy Director of Agriculture, Northern Circle, Jubbulpore on relief by MR. P. D. NAIR, M.A., L.Ag., has reverted to his substantive appointment as Extra Assistant Director of Agriculture and has been granted leave on average pay for four months, with effect from the date of reversion.

DR. R. J. KALAMKAR, B.Sc., B.Ag., Ph.D., Assistant Director of Agriculture, attached to the office of the Director of Agriculture, Central Provinces and Berar, has been appointed to officiate as Deputy Director of Agriculture, Northern Circle, Jubbulpore.

MR. P. D. NAIR, M.A., L.Ag., officiating Deputy Director of Agriculture, Northern circle on relief by DR. R. J. KALAMKAR, B.Sc., B.Ag., Ph.D., has been appointed as officiating Deputy Director of Agriculture, Economics and Marketing, Nagpur *vice* MR. G. D. MEHTA, B.Ag. deceased.

RAI BAHADUR R. V. PILLAI, G.B.V.C., Deputy Director of Veterinary Services, Nagpur, has been transferred to Jubbulpore in the same capacity.

MR. J. S. GURJAR, L.Ag., Extra Assistant Director of Agriculture, Jubbulpore, has been transferred on foreign service under the Indian Central Cotton Committee, as Marketing Officer in connection with the Verum Cotton Marketing Operations.

Bihar

MR. GURUMUKH SARAN SINHA, Stipendiary, has been appointed to act as an Assistant Director of Agriculture in the Bihar Agricultural Service, Class II, *vice* MR. SASANKA BHUSAN RAY, B.Sc., L.Ag., appointed to act as Deputy Director of Agriculture, and has been posted to Kanke in the Chota Nagpur Range.

MR. HARIHAR PRASHAD SINGH, at present employed as temporary Assistant Director of Agriculture in connection with the Sugarcane Improvement Scheme, has been appointed to act as an Assistant Director of Agriculture in the Bihar Agricultural Service, Class II *vice* MR. DINA NATH JHA, B.Sc., appointed to act as Deputy Director of Agriculture, and has been posted to Patna.

MR. MUHAMMAD ISMAIL MALIK, B.Sc., M.R.C.V.S., Deputy Director of the Civil Veterinary Department, North Bihar Range, has been appointed to act as Principal of the Bihar Veterinary College Patna, during the absence, on leave, of MR. R. T. DAVIS, M.R.C.V.S., I.V.S., or until further orders.

MR. PROBODH CHANDRA BHATTACHARJI, Assistant Director, Civil Veterinary Department in charge of the Chota Nagpur Sub-range, Ranchi, has been appointed to act as temporary Deputy Director of the Civil Veterinary Department in the Bihar Veterinary Service, Class I, and to hold charge of the North Bihar

Range, Muzaffarpur, during the absence on deputation of MR. M. I. MALIK, or until further orders.

MR. SUBRATA KUMAR SEN, B.Sc., M.R.C.V.S., Special Officer in-charge of the Central Range of the Civil Veterinary Department, has been appointed on probation for two years to be a Deputy Director of the Civil Veterinary Department in class I of the Bihar Veterinary Service, with effect from the 1st December 1937. He will continue to hold charge of the Central Range with headquarters at Patna.

Assam

MR. NARMADA KUMAR DAS, L.Ag., Assistant Marketing Officer, Assam, has been appointed to officiate as Marketing Officer, Assam, with effect from the 1st June 1937, *vice* MR. L. K. HANDIQUE, granted leave.

Sind

His Excellency the Governor of Sind, has been pleased to appoint MR. W. MUKERJEE, acting Agricultural Engineer in Sind, as Agricultural Engineer in Sind on probation for one year.

Burma

MR. F. D. ODELL, Deputy Director of Agriculture, Burma, has been granted leave on average pay for six months combined with leave on half average pay for six months and four days with effect from the 16th November 1937.

MR. D. T. MITCHELL, M.R.C.V.S., Director of Veterinary Services, Burma, has been granted leave on half average pay for two months and twenty days with effect from the 18th November 1937.

CAPTAIN S. R. RIPPON, M.R.C.V.S., B.V.S., Deputy Director of Veterinary Services, has been appointed to officiate as Director of Veterinary Services, Burma, in place of MR. D. T. MITCHELL, M.R.C.V.S.

MR. G. PFAFF, B.Sc., M.R.C.V.S., on return from leave, has been re-posted as Research Officer and Principal, Veterinary College, Insein, in place of MR. J. BHATTACHARJEE, B.Sc., F.C.S., M.R. C.V.S., who remains as Veterinary Research Officer, with headquarters at Insein.

U NYAN KYAW, G.B.V.C., Veterinary Superintendent, has been appointed temporarily to be Deputy Director of Veterinary Services, Lower Burma Charge, with headquarters at Insein, in addition to his own duties, as Veterinary Superintendent in charge of South Central Circle.

Recent Publications of the Imperial Agricultural Bureaux

I. Obtainable from the Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden, Herts

Periodical Abstracts

	s.	d.
List of publications and papers on Soil Science published in the Empire Overseas in—		
1933	1	0
1934	1	0
Soil Research in the British Empire published in 1935	1	0
Lists of Publications relating to Soils and Fertilisers—		
Published monthly, per annum, post free	10	0
Monthly Letters—		
Free to recipients, within the British Empire, of "Publications relating to Soils and Fertilisers". Subscription, outside the Empire, per annum	4	0
Recent Developments in Soil Analysis—		
Quarterly Supplement to the above publications. Separate copies, each	0	6

Occasional Papers

Technical Communications—		
34. Tropical Soils in relation to Tropical Crops	2	6
Annual Report : For the year 1933-34	0	6
" 1934-35	0	6
" 1935-36	0	6
Bibliographies—		
Bibliography on Coffee	2	0
Catalogue of Journals and Periodicals in the Library of Rothamsted Experimental Station	2	0
Special Publication—		
The Katamorphism of Igneous Rocks under Humid Tropical Conditions (by the late Sir J. B. Harrison)	5	0
Bibliography of Soil Science, Fertilisers and General Agronomy, 1931-34 .	25	0

II. Obtainable from the Imperial Bureau of Animal Health, Veterinary Research Laboratory, New Haw, Weybridge, Surrey

Abstracting Journal

The Veterinary Bulletin—		
1931. Vol. 1. Quarterly (1st Number, April)	7	6
Annual subscription	20	0
Subsequent volumes. Monthly (1st Number, January)	5	0
Annual subscription (postage paid)	40	0

	s.	d.
Indexing Publication		
Index Veterinarius.—Four issues a year. First issue, April 1933. Annual Subscription (postage paid). Volumes I to III mimeographed, Volume IV onwards printed	100	0

III. OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL NUTRITION, ROWETT RESEARCH INSTITUTE, BUCKSBURN, ABERDEEN

Journal

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Agriculture & Live-stock in India

Vol. VIII, Part III, May 1938

EDITORIAL

THE ALL-INDIA CATTLE SHOW, FEBRUARY 1938

THE 1937-38 season will be a notable one from the fact that for the first time an All-India Cattle Show was organized, at the Irwin Amphitheatre, New Delhi, alongside the Annual Show of the National Horse Breeding and Show Society. Though the time available for organising such a show was very short, cattle from most of the important breeding areas were on view and created a great deal of interest not only among cattle breeders but also among the general public, many of whom had previously no idea that such beautiful animals as they saw paraded in the arena could be produced anywhere in India.

Some important breeds were unfortunately not represented, but particular mention must be made of the outstanding display of Hariana, Hissar, Hansi, Sahiwal and Dhanni cattle and Murrah and Nili buffaloes which was organized and sent up to the show by the Veterinary Department of the Punjab and of the following representative exhibits which were sent up by Indian States, *viz.*, Red Sindhi, Malvi and Nimari cattle and Murrah and Jaffarabadi buffaloes from Dhar State, Bhagnaris from Kalat, Girs from Junagadh, Rath and Mehwatis from Alwar, Deonis from the Nizam's Dominions, Nagoris from Jodhpur, Amritmahals and Hallikars from Mysore, Mehwatis from Bharatpur and Kankrej from Radhanpur State.

Inevitably, in such a huge country, considerable expenditure is involved in bringing such a representative gathering of cattle together, and a good deal of suasion was needed in some cases to induce owners to permit their animals to come. Village owners, always suspicious of innovations and the intentions underlying such a proposal, were not at first willing and all sorts of misfortunes were predicted: disease would be rampant, distracted bulls

would be a serious danger to the public and the appearance of the Viceroy's Bodyguard in scarlet would so infuriate them that the Viceroy himself would be in grave danger of his life. None of these dreadful things happened however; no case of contagious disease or serious illness occurred and the provision which was made for isolation and treatment of cases was little used, except to isolate all animals on arrival; the bulls behaved as perfect gentlemen should and the Viceroy was able to arrive and depart in appropriate state and to closely inspect outstanding representatives of the different breeds without the slightest danger. His arrival in state and visits to the cattle show ground in fact gave photographers wonderful opportunities of securing most interesting and informative photographs which must be of great value to all who are interested in Indian rural life and beautiful cattle. Standard photographs against a black background, marked in 6 in. squares, were also taken and will be issued as a supplement to the special bulletin which was prepared by the Animal Husbandry Expert of the Imperial Council of Agricultural Research for this show, giving a brief survey of the different breeds. Moving pictures of the pageantry of the Viceroy's arrival and of the parades and show-yard were also taken and will shortly be exhibited, which give a wonderful impression of this unique show, in its beautiful setting among some of the most impressive examples of Indian architecture of past centuries. It seems certain that such a striking picture cannot fail to appeal to a very wide public, all over the world, and to give Indian cattle the widest possible advertisement, and that the grant of funds from the Government of India which made the show possible was amply justified.

But to provide for the needs of such a variety of cattle and their attendants from all over India, a great deal of arrangement and forethought was necessary. In addition to the provision of the usual judging-rings with accommodation for the public and trade exhibits, suitable food and accommodation for over 400 animals and their attendants of different creeds and communities, had to be supplied, from ten days to a fortnight, and not the least difficult matter which the Secretary had to attend to was to provide food for animals which were not accustomed to the fodder commonly fed to cattle in northern India. Provision for isolation and for veterinary care of sick had also to be made, and camp for the officers in-charge and kitchen and feeding accommodation was provided as well as suitable food and proper sanitation for the men as well as their animals. Such difficulties as arose were however overcome and all concerned with the organisation of the show are to be congratulated on the way in which between four and five hundred animals were assembled and dispersed without mishap.

Moreover, it is encouraging that in the course of the show a number of animals were sold, at prices far higher than they would otherwise have realized, and it is hoped that, with wider support, it may be possible to establish the All-India Cattle Show as an annual event of great importance to breeders of pedigree stock all over India.

A Jat of the United Provinces—A Soldier Cultivator

ORIGINAL ARTICLES

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

X.—THE UNITED PROVINCES CULTIVATOR

1. THE JAT CULTIVATOR

BY

ABDUL HAMID KHAN SAHABZADA

Divisional Superintendent of Agriculture, Western Circle, Meerut

THE Jat cultivators of the United Provinces are mainly concentrated in the western districts but have now spread more or less throughout the Province wherever conditions promise a livelihood from cultivation and cattle. With traditions deeply rooted in agriculture they are a sturdy and independent race, loyal alike to their land and to its service in arms. Wherever a Jat community is found, there one can look with certainty for a high standard of cultivation, a long-standing tradition of hospitality, an independent outlook, directness of speech, and loyalty to one's salt.

Let us look at a typical though perhaps prosperous above-average representative in the State tube-well area in Meerut district. As we are proceeding on our way, we remark excellent crops of sugarcane in solid blocks, with the tube-well building at the highest point in the area. Reaching our village, we observe that the Jat houses of brick, or with neat and well-built mud walls, are far superior in quality and maintenance to those of the general run of cultivators of the Province and that the people are better dressed and appear both healthier and happier. Entering the village we are greeted and invited to sit and to rest a while on a strong well-built charpoy. A peep into our host's courtyard shows the cattle and young stock being given their morning feed. The cows are of the Hissar type, giving a fair quantity of milk and there seems to be an abundance of green fodder. The care given to the cattle is obvious.

The head of our host's household is the old grandfather, hale and hearty, and a personality in the councils of the village panchayet. Retired from a famous Jat Regiment, he is full of stories of his adventures in the Great War in France and Mesopotamia. The care of zemindari and cultivation he has handed over to his elder son, our host himself contributing traditional council and shrewd though somewhat conservative comment. The younger son is with "the Regiment" where his recent promotion has brought joy to the heart of the old warrior.

There are four grandchildren, two boys, of whom the eldest has already followed the family tradition of military service, and two girls shortly to be married. The father has already made arrangements for borrowing from the Baniya for the girls' marriages "Every one must spend to put up a good show when one marries one's daughter". His savings were not enough, as he wanted to invest in improved agricultural implements which were so much the talk of the village. The Deputy Saheb had given their village a set of improved implements as aid to the *Gram-sudhar* (village uplift). Our host had tried these and found that they were effective "if one followed the rules of good husbandry", and he must have his own set.

The youngest son attends the village school. On the subject of schooling the grandfather is somewhat scathing, telling his son that it is no use sending the boy to school. It will only result in his running away to town and becoming a clerk! "We are not that class, either we must till the soil or we must be soldiers."

The Jats, as a race, are fine ploughmen with traditional knowledge of the art of tilling the soil at the proper time and of preparing a fine seed-bed. That our host is no exception is obvious from his land and the condition of his crops. These are his first interest and his main delight; but when the work of the day is over he is happy to sit in the evening in his small *chaupal* (raised sitting-out platform) and to discuss the events of the day and village interests to the accompaniment of his *huqqa*. The *Chamars* of the village are at the moment somewhat of a problem. The introduction of tube-well irrigation, the block sowing of crops with re-alignment and straightening of field boundaries, the introduction of labour-saving devices have reduced the demands upon daily labour, thus creating a minor unemployment problem. Our host had suggested to help them provided they settle down to cultivation of the land but they prefer the freer if more precarious existence by daily labour and selling grass and fuel in the town.

That our host and his fellow Jats are alive to the possibilities of agricultural improvement is evident when we walk through the fields. He himself has 300 bighas (about 50 acres) of zemindari, of which he cultivates 200. Of this he has already remodelled 80 bighas along with his fellows, under the advice of the Agricultural Development Officers. The fields have been reshaped with straight *mends* (field boundaries) and direct water channels, and the crops are sown in solid blocks with roadways running through them, made by the owners of the fields themselves. Once the advantage had been realised by the village, there was no objection to re-adjustment of field boundaries and a division of the irrigated area into blocks which followed the approved rotation. Thus without the difficulties of consolidation of holdings they had reaped most of its advantages. As he proudly explained, "we are following the old system of *Har Kheti*, *i.e.*, division of the area into solid blocks for *Kharif*, *Rabi* and *Dofasli* with a little grazing and

a small grove of mangoes ", and they were quite happy with the result of their co-operative effort. Yields were increasing, irrigation had become easy and watching the crops a game. Irrigation from the tube-well had sent their cane shooting to the heavens.

He was rightly proud of his cane crop which we estimated at 800 maunds to the acre. This was nearly all destined for the sugar factory. Only one *Kolhu* (bullock power crusher) remained in the village for *gur* for local consumption. "This year," he said "we are taking all to the factory. We get only Rs. 2-4 for a maund of *gur* which hardly pays its way and *gur* is difficult to keep. Sold to the factory we have no further worry with it. We have contracted for the whole lot through the Co-operative Inspector who has set up a centre in the village".

Thus a Jat is not shy of using agencies which are to his advantage or of adopting unfamiliar methods when their value has been demonstrated. The cane had been sown in lines suitably earthed up and where necessary tied in stools to prevent lodging. Green manuring with *sanai* is becoming a general practice in the village and in our host's opinion was "a great friend, particularly of the small cultivators, whose stock of dung manure is insufficient."

A Jat finds plenty to keep him busy throughout the year in the fields with his crops and his live-stock. The high spots of his life are occasional. A chorus at *Holi*, merry-making at *Dusehra*, an occasional visit to market, and domestic ceremonial occasions appear to afford all the variety he desires outside the care of his house, his cultivation and the affairs of the village. Let there, however, be word of a wrestling match, and whether he is of a suitable age, or too young, or too old to participate, he will be there unless his major interests prevent him.

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

X.—THE UNITED PROVINCES CULTIVATOR

2. THE MUSLIM CULTIVATOR OF OUDH

BY

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Although practically 99 per cent of Muslim cultivators in Oudh belong to the Sunni sect, any Muslim, whether he is Shia or Sunni, (Sheikh, Moghal or Pathan) may, without prejudice, adopt the profession of a cultivator. Most Sheikh and Pathan Muslims in the villages are engaged in side-industries such as oil-crushing, spinning, pottery and the rearing of goats and cattle chiefly for milk. This is done, however, in addition to their ordinary work as cultivators. Of the Sheikhs and Pathans, both of whom are Sunnis, the Pathan represents the majority of the Sunni cultivators. He is a staunch Muslim and is recognised generally by a beard typical of his class, with moustaches trimmed short or shaved in the middle. He follows strictly the teachings of Islam, especially in the matter of regular prayers and fasting during the month of *Ramzan*. In places where he is in a small minority and very much influenced by the Hindu majority, he will enjoy such Hindu festivals as *Diwali* and *Holi*. This applies, however, to the illiterate cultivator only.

The Muslim cultivator gets his children taught to read the Holy Quran but not necessarily to read Urdu. The children are taught to respect their religious observances. The Pathan cultivator of Oudh is generally well built and of robust health. He is both industrious and skilful. He leads a simple life wearing a cloth like a *dhoti* known as the *tahband*, and a shirt or *kurta*. These are made of village-spun cloth. During winter he wears, in addition, a rustic form of a tight-fitting garment known as a *shaluka* in which, between the lining and the cover, is stuffed a liberal amount of cotton. His bedding at night consists of a mattress of paddy straw, either on the ground or on a cot, and a covering of rough cloth. His food consists chiefly of pulses, vegetables, rice and unleavened bread made of either wheat, barley, maize or *bajra*. When he eats meat, it is generally beef. He both chews and smokes tobacco.

A Muslim (Pathan) Cultivator of Oudh

The young Muslim cultivator marries between the age of fifteen and twenty. The parents do their best to provide money for feasts, dances and the presentation of silver ornaments to the bride.

His womenfolk help the Muslim cultivator in his daily work in the fields. They both take pride in raising good crops. The standard of cultivation is generally good and plenty of manure is given which is obtained from the cattle he keeps. He is also industrious in providing irrigation from wells for his crops. Being a shrewd and intelligent man, the Muslim cultivator of Oudh looks upon his profession from a business like point of view and is generally a successful cultivator.

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

X.—THE UNITED PROVINCES CULTIVATOR

3. THE KURMI CULTIVATOR

BY

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THE Kurmi or Kumbi is a good, hard-working cultivator. Agriculture is his main and hereditary occupation. His ways of life are simple. His women-folk do not observe *pardah* and are free to work outdoors without any social let or harm. Widow remarriage is common among them. It is true that in the olden days they were not recognised in the higher social groups of the Hindu caste system, but they were never classed as untouchables. From ancient times they have been occupying the advantageous position of the producers of food which had a ready market.

With the establishment of a stable form of Government, the various legislative measures gave security of tenure and removed other disabilities in the way of ordinary farmers. Then the Kurmi made rapid strides in economic matters and to-day we find some very big landlords amongst Kurmis. The key of economic prosperity and solvency of an average Kurmi family of farmers is his industry, simplicity and docility. The head of a Kurmi family will arise generally one hour before sunrise. He will have a few whiffs at his *hookah* and will finish his morning ablutions. He will go to his fields and start work at sunrise with other members of his family, leaving a few women at home to take care of the children and cook food for all. After working for about three hours he stops work for about thirty minutes for breakfast. Breakfast mostly consists of parched grain and sometimes *gur*. After breakfast work is resumed and is continued till about twelve noon when he returns home. He takes his bath in a river, tank or well according to the facilities available and then enjoys his midday meal. After finishing this meal he rests for a while, and then sets off for the afternoon work in the fields till sunset.

On his return from a day's work in the field he is busy at home with some indoor occupations such as the care of cattle and live-stock, extraction of fibre from *sann*-hemp, making ropes and string, *tat*-weaving and so on for a few hours till the night food is ready. This night meal is taken at about 9 P.M. and then he retires for the night.

A Kurmi Cultivator of the United Provinces

The agriculture of Kurmis, despite its antiquity, is still primitive and largely empirical. Modern scientific developments, which have revolutionized the agriculture of other civilized countries, have had but little effect on the agricultural practices of Kurmis. They handle the wooden ploughs to-day which were used by their forefathers from time immemorial. Their general illiteracy, deep-rooted superstitions, and small and scattered holdings are some of the great impediments in the way of their agricultural progress. No wonder, then, that the agriculture practised under such conditions should remain unaffected by modern improvements. It is rather creditable to the Kurmi cultivator that, working against heavy odds, he manages to produce excellent crops on his fields and very successfully competes with his more advantageously placed fellow cultivators. He possesses a very clear knowledge of agriculture as a result of tradition handed down from generation to generation and is perfect in the art of crop raising. Every Kurmi cultivator commits to memory a large number of agricultural sayings on different agricultural subjects, such as preparation of seed-bed, time of sowing, manuring, weather forecasts, live-stock and so on. "Ghagh" the originator of most of these agricultural sayings is said to have been a very intelligent Kurmi agriculturist in the hoary past.

A Kurmi farmer is generally guided in his agricultural practice by experience, both hereditary and acquired, and by these agricultural sayings. He uses simple and cheap agricultural implements and keeps one pair of bullocks for every five acres of land. He also keeps two to four milch animals on his farm. He likes and plants some fruit trees on his holding. Such fruits are generally mangoes, *Kathal*, *Mahua*, *Jamun*, *Ber*. He grows also a few clumps of bamboos which he requires for the repair of his houses and other agricultural work. He will prefer to have a masonry well on his holding for the irrigation of his crops, but, unfortunately, in the majority of cases the conditions do not permit of this.

To augment his agricultural income the Kurmi farmer generally takes to some other work such as (1) Making ropes and strings for sale, (2) Weaving *tats* (rough cloth) for sale, (3) Plying carts for hire, (4) Service on another village farm or in towns as *chaukidar*, *chaprasi* or *munshi*.

The house of an average Kurmi is generally built of mud walls and tiled roofs. It consists generally of a central courtyard surrounded on all sides by rooms. There is generally one entrance door facing east, north or west. An entrance door facing south is considered inauspicious. He keeps his cattle in thatched sheds. The rooms of the residential house serve also as store-house for farm stock and generally one or more rooms are reserved for this purpose.

The diet of a Kurmi farmer is extremely simple. In fact it is doubtful whether he ever has a well-balanced diet, considered from the scientific standpoint. The breakfast consists generally of parched grain or *sattu* (gram and barley ground

together) with or without some *gur*. The midday meal is generally *sattu*, parched grain with *gur* and inferior milk products. Occasionally he takes boiled rice, or pulse chapatti also for the noon-meal. The night meal consists mainly of chapatti, boiled rice and pulses occasionally, also some home-grown vegetables cooked with oil or ghee. Seasonal fruits such as mangoes, *ber*, etc., are taken if available in the home orchard.

The dress of the Kurmi farmer is very simple. The man remains contented with a pair of *dhoties*, one *banain* (vest) with half-sleeves, one *angoochha* (towel), one bed-mat or *sujni* (coarse undersheet) and a *chaddar* or sheet during summer. In winter he requires one double cotton *kurta* (shirt) and either a blanket or a quilt more to help him through the cold season.

A Kurmi woman requires one pair of *dhoties*, two jackets, one *sujni* and one quilt per year, one *lahnga* (skirt) on ceremonial occasions or an ordinary *sari*, with no underwear. Children below five years are provided with two or three shirts and a cap. For ceremonial occasions they generally prefer to keep finer clothes.

The amusements of Kurmis are also very simple. The Kurmi children play different games such as *kabaddi*, *dola pati*, *chikia; dudari* (all team games), *gulli danda* (tip-cat), *goli*, (marbles), wrestling, *dund*, *baithaks* (physical exercises) and so on. The adults generally sit together in a *chaupal*—an open thatched room—and chat in the afternoon and after work at night. The recitation of the Ramayana, local songs (*Birha*, *Lorik*) and also story-telling are common features of amusement. On the days of religious festivals they attend local melas and fairs of which there are plenty.

Typical Bundelkhand Cultivators

A Bundelkhand Cultivator and his family

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

X.—THE UNITED PROVINCES CULTIVATOR

4. THE BUNDELKHAND CULTIVATOR

BY

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ALTHOUGH the Bundelkhandi may not appear at all out of place in many parts of Central India, in the United Provinces he is a type somewhat apart. But if the countryside which produces him is compared with the rest of the province some differences in the man are only to be expected.

Geologically Bundelkhand is a piece of Central India, the natural features of which have little in common with the remainder of the province in which it is included. Here are no extensive plains of rich alluvium, watered by slow-flowing rivers, but undulating expanses made up of soils widely varying in character and of quite another nature and origin. In such a country, with its confused and rocky hills, its fast-flowing streams, lined usually with a maze of ravines, it is not surprising to find an agriculturist and a system of agriculture distinct from that of the remainder of the province.

Though subject in a general way to the same vicissitudes of life as the average cultivator of Northern India, historic, social, and climatic conditions have combined to produce here a tiller of the soil, whose outlook on life is sufficiently distinct to appear a little foreign to other cultivators of the same province.

As a cultivator he has a reputation for being somewhat lazy and easy going; as a man, a cheerful optimist relying largely on custom and even superstition to guide him. Nevertheless, he has developed a system of agriculture, which deals quite effectively with the cultivation of the varying types of soils under the difficult weather conditions which are his heritage, for nature has not been too generous to him. Historic conditions too have been against him. The Mughal, Maratha, and Bundela invasions may have been forgotten, but a sense of security is a thing of slow growth. Enterprise moreover is not encouraged where crops are largely at the mercy of the fluctuating seasons, where in favourable years little is required to secure average crops, but in others the most industrious husbandry often fails to ward off disaster.

His agric ulture is therefore of the extensive type. Proper soil preparation has to give place to hurried tillage and single crops to mixtures like gram and wheat, and gram and linseed, or even gram, linseed and wheat in the *rabi*, and *til* and *arhar*, or *juar* and *arhar* in the *kharif*. In the hope of striking a lucky combination of a large sown area and a favourable season, more land is farmed than can be properly controlled with the man and bullock-power available. These conditions are well suited to the *kans* weed which in many areas takes a heavy toll, and, spreading fastest in the seasons most favourable for crops, robs the cultivator of most in those very years when it would be expected that he would be able to put a little aside as a reserve.

It is true that the Bundelkhandi has methods for dealing with this pest. But they are extensive too. If a *kans*-infested area is left for grazing for about fifteen years, or flooded with water for a season or two, much of the *kans* is destroyed, but not for him the method of direct attack with a *phowra* (spade). His natural distaste for the *phowra* is shewn again in the comparative lack of bunds to prevent the run-off of rain water, which in his retentive *mar* and *kabar* soils and undulating contours, would go far to mitigate the ill effects of badly distributed rainfall and loss of fertility by erosion.

With cattle his ideas also run on extensive lines. Status and wealth are in many areas largely judged by numbers, which extensive grazing facilities do much to encourage. With fluctuating seasons, cattle share with their owners the experiences of both want and plenty. In good seasons when grass is to be had for the cutting, *juar* stalks can be seen left uncut in the fields, though they may prove an infernal nuisance and clog up the plough and *bakhar* (blade-harrow) when the land is being prepared for the succeeding crop. Where such practices prevail, a cultivator has only himself to blame if he earns a reputation for indolent optimism.

In hard times, however, the Bundelkhandi can make the best of the scanty resources at his disposal and though he may lack in persistence and moral courage, in physical pluck he is not wanting. His work is usually planned to meet his immediate needs, and a high value is set on leisure. Display is not one of his failings, but on occasions, as at marriages, he is as inclined to indulge in improvident extravagance as do cultivators in many other parts of India.

His diet is simple and, though coarse, appears both satisfying and nutritive. *Juar* is his staple food in winter but wheat and gram (*bejhar*) take its place in summer. With *maheri*, i.e., crushed *juar* and buttermilk, *gur* and *mahua* fruit, *mung* and *arhar*, he is able to add variety and other nutritive elements to his diet. Brinjal, onions and chillies are his chief vegetables. In ghee and milk he is probably better off than cultivators in many other parts of the province, as extensive grazing areas permit of cattle, of somewhat low quality, to be kept in rather considerable numbers.

His home surroundings have an appearance of both comfort and happiness. The house, usually two or three-roomed, though low, is substantially built, often brick and stone as well as mud being used in the walls. Both house and courtyard walls are roofed with red tiles. The doors are particularly substantial, and characteristically low in height, a fashion probably dating back to the stormy days when the countryside was subject to visitations of marauding invaders, but now explained as a custom which makes anyone entering first bow as a sign of respect. About the houses is an air of cleanliness and neatness which does credit to the womenfolk responsible for them. On each side of the entrance is a neatly made platform regularly plastered every *Amawas* (New moon), and *Purnama* (Full moon). Here the family gather and enjoy much of their leisure in chat with their neighbours.

Besides being responsible for the cultivator's house, the Bundelkhand woman shares much of the burden of the work in the fields, where, on ordinary days, her characteristic red *dhoti* gives to the ever-changing rural setting, a splash of colour which, on high days and holidays, is further heightened by a red *chadder* and *lahnga.*

With heavy *painjana* (bangles) on her ankles, made usually of brass or zinc, hollow and carrying loose cooper balls inside them to produce sound, she usually has music of sorts wherever she goes. This heavy gear which adorns the women's ankles, and the men's heavily soled leather shoes with their flaps and turned up toes, made to give real protection from the thorns and stones, have earned for the Bundelkhandi considerable distinction in foot-wear. This shoe, made in pieces, all of which are separately replaceable, is definitely practical in its construction, though so heavy that the economically-minded often prefer to carry them wherever enough smooth going permits.

The Bundelkhandi's future is not without its brighter prospects. His countryside is faced with no problems of over-population. There is little pressure on the land, even in the canal-irrigated areas. In his soil is undoubted wealth waiting to reward the industrious. It is a pity that the Bundelkhand's virtues are so largely negative ones. His country needs a persistent and positive type of agriculturist, who can set a course of land development, and stick to it, no matter the weather or the seasons. It calls for men willing to put muscle into measures to conserve the soil to stop the drain which wash and erosion take of its wealth. For centuries it has been asked to respond to hand-to-mouth and pauperised systems of farming and it is hardly to be wondered that its soils now respond somewhat grudgingly. But the Bundelkhandi is slowly learning that his extensive systems do his soils no good, and that in irrigated areas he often wastes both labour and water, and slowly he is becoming aware that the response of the land to the sunshine and the rains, fickle as the latter may often be, is somewhere proportionate to the fertilizing material and the cultivation he is prepared to put into it.

A NOTE ON COLLECTION AND CULTIVATION OF MEDICINAL PLANTS

BY

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During the last twenty-five years a number of drugs of Indian origin have assumed importance which they did not possess before, especially from the point of view of foreign trade. Several manufacturing firms established in India use the raw material produced in this country in the manufacture of finished products. Although India is exporting some of its crude products to foreign countries, she is still importing large quantities of crude drugs for its internal consumption. It is a matter of very great concern that the raw materials collected in this country are often not up to the required standard and not only does the fair name of India suffer as a producer of unreliable material, but there is considerable economic loss. Indian *Ephedra*, for example, came into prominence ten years ago from the point of view of the foreign trade, but soon fell into disrepute, and we have to thank ourselves for practically the total extinction of the foreign trade in this drug. Investigation into the causes which led to this state of affairs came too late to stem the slump in the trade in this commodity.

If drugs of standard quality can be supplied we feel confident that in spite of all that has happened, there is a promising future for the expansion of the export trade and internal demand. It is our object in this paper to draw attention to some of the points which the collectors of medicinal drugs growing in a state of nature, and the present and the prospective cultivators should bear in mind in order to obtain good quality of the standard material. We also propose to indicate how those carrying out investigations in this connection can improve the existing state of affairs.

Collection of drugs growing wild

It is a matter of common knowledge that there is a good deal of variation in the active principles in different organs of a plant and in different seasons in the

same organ of plant. What is not realised by many collectors and others is the fact that the same organ at the same time will show remarkable differences in the contents of its active principles. For example, the young and the old leaves on a plant will show considerable variations, and unopened and opened flowers will likewise differ despite the fact that they are collected at the same time. The interest of the unskilled labour employed for collecting is to collect the maximum amount of material in the minimum time since it is a common practice for wages to be paid according to the weight of the material collected. If, however, strict control is to be exercised, the out-put of the collectors will be naturally less, so they must be paid more and according to the quality of the material gathered. This can be done easily because, if the quality is good, better prices will be obtained which will not only compensate for the extra cost of labour but will also bring more to the producer. It must be understood that in the production of the finished product the cost of the raw material is not the only consideration for the manufacturers. Considerable expense is incurred on account of solvents, chemicals, personnel employed in the manufacturing process, packing, labelling and marketing. It will thus be seen why the manufacturers would be glad to pay more for the drug which is up to standard so far as the active principles are concerned.

No hard and fast rules can be laid down with regard to the time of collection of drugs, but where detailed information is not available the following general rules for the collection of material should be observed. The reason of this is that in many cases it is not known exactly when the active principles attain their maximum quantity and research is necessary to work out this factor in many of even the common and important medicinal plants :—

1. Roots, rhizomes and bark should be collected in late autumn or early spring.
2. Leaves, when photosynthetic processes are most active, which is usually about the time of development of flowers and before the maturing of fruits and seed.
3. Flowers, prior to or just about the time of pollination.
4. Fruits, near the ripening period, *i.e.*, fully grown but unripe.
5. Seeds, when fully mature.

Cultivation of drugs

It has been stated that drugs should be collected at proper stages of development in order to get the maximum amount of the active principles, but in some cases it is not possible to exercise this control. For example, some of the plants are gathered in forests difficult of access and they are neither gregarious nor plentiful and, therefore, difficult to collect at the proper time. In such cases, it may be worth while to bring them under cultivation. This should be done after mature consideration and after careful investigation of the suitability of soil and climate

for producing active principles of standard quality. Investigations of this kind are laborious and expensive and beyond the means of private individuals. They can only be undertaken by Government organisations such as the Forest Department or the Department of Agriculture. In such investigations the objective should not be simply to grow the plant but also to find means to improve the quality of the active constituents. There are many examples where the active constituents of plants growing in a state of nature have improved by proper cultivation. India is so rich in its resources of drugs growing in a wild state and the labour is so cheap, that unless a better yield of the active principles is obtainable under cultivation, it will, in many instances, not pay to cultivate them. This, however, does not imply that a plant which is found growing wild in some parts of the country should not be cultivated in another part if there is demand for it. On the contrary, cultivation may be necessary merely on the ground of obtaining an increase in the active principles besides other economic considerations.

We will now consider the question of those drugs which are not found in India or the exotics which have been introduced. Either the finished products of these drugs are imported into India or the raw material is obtained by agencies abroad. If it is considered desirable to cultivate medicinal plants in this country careful trials should be carried out by Departments of Agriculture to ensure that good quality can be produced before the agriculturists can take it up. It is a matter of regret that such experiments are not often carried out on proper lines. Often seeds are sown, the plants grow up, blossom, set seeds, and die without the investigation required at various stages. Seeds are collected and the same thing is repeated the following year. In the case of perennials sometimes a bed and sometimes a single plant tells its tale of neglect. In other cases attempts are made to increase the yield per acre by selection or breeding, but no attempt is made to determine how and at what stage the maximum yield of active principles could be obtained. In a few instances excellent work has been done in this connection. For example, the Agricultural College, Lyallpur has, by selection, succeeded in obtaining a larger inflorescence of *Plantago ovata* Forsk. and consequently a larger number of seeds per plant. In the Forest Research Institute at Dehra Dun cultivation of a few plants has been tried on proper lines.

Drug cultivation is a problem from which spectacular results cannot be expected unless experimentation and research on proper lines is carried out for prolonged periods. Unless the raw materials are up to the required standard as far as active principles are concerned, they cannot be used, will have no demand, and therefore cannot be a financial success.

Drugs that are cultivated for use in the Ayurvedic and Unani systems also need proper attention. Rigid rules about the time and manner of collection of a particular plant or parts of plants are laid down in books of these systems which

show that old physicians were aware that only under certain conditions is the plant therapeutically active. Unfortunately the present-day collector does not take these instructions seriously.

RESEARCH ON DRUGS

We have stressed that the medicinal plants, whether obtained from a state of nature, or whether cultivated should have the requisite quantity of active principles in them. We will now say a few words as to how this can be obtained :—

1. Proper identification of the species is the first important step and if there are several varieties and forms of the same plant, each one of these should be carefully examined in order to determine which gives the best yield of active principles. Sometimes light can only be thrown on this aspect of the problem by extensive work in the field. For example, *Artemisia* from Kashmir and Kurrum could never have reached the present high standard of active principle content if it was not for the patient and careful work in the field. There are two forms of Kurrum *Artemisia maritima* Linn. In the early stages of growth one has deep reddish stems and the other greyish. The stems of both turn brownish at the time of maturity, but it is the form with deep reddish stems in the early stages that contains santonin and not the other. There is absolutely no other botanical difference between the two forms. The differentiation of these forms defied even skilled botanists for a long time and considerably hampered the progress of the santonin industry in India till the field work brought this fact to light. This is a very remarkable example of the fact that even the slightest differences in a plant may reveal so much unexpected differences in the content of active principles.

2. In the study of the active principles in a particular organ of the plant, for example the leaves, it is not only essential to examine them at different seasons of the year, but it is necessary to study the younger and older leaves from different regions of the plant, simultaneously. Almost always some difference will be found to exist between the various stages of growth of a particular organ although collected at the same time and from the same plants. Thus the younger leaves at the ends of the branches and tops give results different from the older ones. If care is not taken in collecting samples, there may be different proportions of young and old leaves in different samples and the result of analyses will be confusing especially if the variations are very great. It is only by careful sample collection and testing that it is possible to eliminate the poor quality growth stages collection of which will not be advisable.

3. In making comparative analyses, when one plant does not yield sufficient material required for analyses, for example while studying the effect of sun and shade drying, it is advisable to collect samples from individual plants separately and divide each into two parts. Portions of each should then be mixed to constitute one sample while the remaining halves mixed together would form the other sample. This gives more accurate results and eliminates the differences in the content of active principles present in individual plants. If more than two samples

are required for comparative purposes each plant can be divided into the desired number and then mixed.

This indicates the importance of sampling in the assay of drugs. The question of grading is equally important and must not be lost sight of especially if the drugs are meant for commercial purposes.

4. In addition to the above, the seasonal variations, climatic and altitudinal effects, method of drying, effect of decomposition of the raw material which is sometimes unavoidable especially when dealing with large quantities, effect of storage and any other point which might arise in the case of any special drug should be carefully studied.

General remarks

Once all these aspects have been studied a judicious analysis of the results is necessary to transform the strict scientific results into commercial possibilities. Until this is done, it will not be possible to exploit fully the resources of wild drugs nor will it be possible to determine what plants can be successfully cultivated from the point of view of commerce. The plants which are now thought to be unsuitable for cultivation because they bring insufficient return to the cultivators but do not definitely cause a financial loss, should be properly investigated in the light of the above observations. They must be cultivated by the Departments of Agriculture in their experimental farms and thoroughly studied before they can be definitely abandoned or adopted for the purposes of cultivation by the agriculturist. Some of the Provincial Departments of Agriculture are cultivating the medicinal plants and there is no reason why others, who are not doing so at present, should not devote some attention to this important aspect. The samples should be carefully selected and proper records of analyses kept with a view to proper investigation. While the actual cultivation of drugs for experimental purposes and on a commercial scale is primarily the concern of the Departments of Agriculture and Forests, the resources of the Medicinal Plants and Food Poisons Inquiry are always available to them to carry out chemical analyses, tests and advice on any points which may arise. It may be noted here that some of the institutions and departments are experimenting on too many medicinal plants with the result that hardly any one of them receives the essential thorough study. Experimental cultivation of a large number of plants is certainly to be encouraged but only a few of these should be selected for intensive study at a time. It would be better to grow one important plant and thoroughly study it from every point of view than to grow ten plants and not study them thoroughly.

There is another point which must be emphasised. It would be no use trying to cultivate such plants as ephedrine-yielding *Ephedra*, santonin-yielding *Artemisia*, *Saussurea lappa* C. B. Clarke, etc., in the plains. They are inhabitants of higher altitudes and cooler climates and may not adapt themselves where these conditions are not obtainable. Such cultivation may of course be done for academic purposes and it will be seen that many difficulties will arise in raising the plants

even under expert care and more often than not they will be found unsuitable for cultivation on a larger scale. Our experience is that the energy spent in this direction will not be usefully spent and it is not likely to bring results of practical value as would be the case, if proper selection is made beforehand. Similarly, there is a greater likelihood of plants of warmer regions thriving better in environments which are more akin to their natural habitat. In short, plants likely to be suitable for particular localities are those which thrive in nature under similar environmental conditions.

Lastly we would like to emphasise that there are some plants which should and could be cultivated as regular crops, such as *Plantago ovata* Forsk. Suitable places for others would be the ridges among the cultivated fields and any other waste land which may be available. The main idea of cultivating medicinal plants is in most cases to provide additional income to the agriculturists and not to replace their normal crops.

The following is the list of plants* which, in our opinion, are likely to be successfully cultivated in India, if proper care and attention is devoted to them. The popular names and the part or parts of the plants used are also indicated and localities suitable for the cultivation of each of these have been given. Besides their medicinal value, some of these plants have other economic uses and these should not be overlooked. Further studies in connection with medicinal plants, which may be profitably grown by the agriculturists, are in progress and the results will be published in due course.

1. *Anacyclus pyrethrum* DC. (The Pellitory of Spain)—Roots.

The plant is indigenous to north Africa and has been introduced into south Europe but has not yet been reported as grown in India. Large quantities are imported into India, chiefly from Algeria. It may be tried in both the East and West Coasts of India near the sea coast. There is quite a large demand for this drug in the indigenous systems of medicine as a cordial and stimulant. It is also chewed as sialagogue and is used against toothache.

2. *Atropa belladonna* Linn. (Deadly Nightshade)—Leaves, roots.

The plant is found wild in the Himalayas from Simla to Kashmir at an altitude of 6,000 to 12,000 ft. Considerable quantities could be profitably grown in suitable situations. It would grow best in the western Himalayas at altitudes between 6,000 to 8,000 ft. in places where the soil is porous, containing sufficient mineral constituents (potash, soda, lime, etc.) and drainage is good. Not much manuring is required. There is a large demand all over the world and it is used in medicine as a sedative, antispasmodic, anodyne and mydriatic.

3. *Cassia acutifolia* Delile. (Alexandrian Senna of commerce)—Dried leaves and dried ripe fruits.

This plant is a native of Nubia, of Kordofan and Sennaar, and other parts of

*Those marked with asterisk are used only in the indigenous systems of medicine.

Africa. It is likely to grow in similar localities as described in case No. 4 and has the same use.

4. *C. angustifolia* Vahl. (Indian or Tinnevelly Senna)—Dried leaves and dried fruits.

The plant abounds in the Yemen and Hadramant in Southern Arabia, and is also found on the Somali coast. It is cultivated in Tinnevelly and Madura in the south, and in Poona in the Bombay Presidency. The Indian product is generally considered to be of a better quality than the Arabian variety which grows wild. There is room for further extension of its cultivation, both for internal consumption and export. The plant is likely to thrive well in places with light rainfall, say about 35 in. per year and having equable temperature—the maximum of about 95°F. and the minimum not going below 50°F. in winter. The soil should be of a grey alluvial kind, consisting of a mixture of sand and clay. It is used in medicine as a purgative, and as a household remedy for the same purpose.

5. *Chrysanthemum cinerariaefolium* Vis. Syn. *Pyrethrum cinerariaefolium* Trev.
6. *Ch. coccineum* Willd. Syn. *Ch. roseum* Adam ; *Pyrethrym roseum* Bieb.

} Pyrethrum (1).

The flower heads are in very great demand all over the world, as an insecticide. So far, they have been experimentally grown in India at an altitude of 5,000 ft. in Kashmir and also at Dehra Dun in the United Provinces and the top of Pareshnath hills in Bihar. Temperate outer Himalayas would appear to be most suitable, but they may also be tried in the Nilgiris and lower hills of Manipur (Assam). No. 5 is commercially more important at present. There is likely to be a very large demand in India for this drug as a larvicide for mosquitoes. (For detailed information see ' Pyrethrum Flowers', Gnadinger, C. B. , 1936).

7. *Citrullus colocynthis* Schrad. (Colocynth)—Dried pulp of the fruit.

The roots and whole fruit without seeds are commonly used in India ; the dried pulp of the fruit is officinal in British Pharmacopœia. The plant grows wild in waste tracts of north-west, central, and south India and the fruit is collected from plants which grow wild on certain desert tracts of north-west India. Large quantities of the fruit are, however, annually imported from Europe, Arabia and Syria. In Spain and Cyprus the "colocynth apples" are actually cultivated for purposes of export. The plant will do very well in the plains of north-west, central, and south India. It is in quite a large demand as a purgative both in the Western and indigenous systems of medicine.

8. **Crocus sativus* Linn. (Saffron)—Stigmas.

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*Those marked with asterisk are used only in the indigenous systems of medicine.

(1) Since this article was sent to the press, pyrethrum flowers cultivated at Baramulla, Kashmir, have been chemically examined at the School of Tropical Medicine and found to contain 1·02 per cent of *pyrethrins*. This compares very favourably with foreign-grown stuff. Biological tests are in progress and the results will be published in due course.

It is grown in France, Spain, and Italy, but most of the Indian supply comes from France, China, Kashmir, and a small quantity from Iran. In Kashmir it is grown at Pampur near Srinagar at 5,000 ft. It prefers moderately dry and cool climate. It is used to some extent as a stomachic, antispasmodic, stimulant and aphrodisiac in indigenous system of medicine. There is, however, a large demand as a colouring and flavouring agent for foodstuff. Much more could be cultivated for internal consumption in India and for export purposes.

9. *Digitalis purpurea* Linn. (Digitalis)—Leaves.

It is a native of western Europe but is now extensively grown in many parts of the world. In India Digitalis cultivation in Kumaon and Kashmir has great possibilities. Although it does very well in the eastern Himalayas, there are difficulties of drying and storing in a wet climate. In Kashmir it is cultivated at Tanmarg at an altitude of about 6,000 ft. On the whole, places with lesser rainfall during early to mid-summer should be preferred. Several suitable places in the north-western Himalayas at altitudes of 5,000 to 7,000 ft. could be found where it would do well. It is used in certain heart conditions to increase the tone, excitability and contractility and the refractory phase of the cardiac muscles. There is quite a large demand for it. *D. lanata* Ehrh., which has been worked at the School of Tropical Medicine is less cumulative, rapidly slows the pulse rate by 50 per cent and less deteriorating in the Tropics than *D. purpurea*. It has been successfully cultivated in Kashmir.

10. *Eucalyptus globulus* Labill. (Eucalyptus)—Leaves for distillation of oil.

It is an Australian plant whose introduction into India has met with complete success on the Nilgiris and other hill ranges of south India. It may also be tried at elevations between 4,000 to 5,000 ft. in the north-west India. Above this altitute it is liable to suffer badly from snow. It is used specially in bronchitis as inhalation and also internally as an anthelmintic. In addition it has a large demand as an insect repellent.

11. *Eugenia aromatica* (Linn.) Baill
Syn. *E. aromatica* Kunze; *E. caryophyllata* Thunb.; *Caryophyllus aromaticus* Linn.—Dried flower buds. } Clove.

Cloves met with in Indian bazars are often old and inactive. Those suited for medicinal purposes should have a strong fragrant odour, a bitter spicy pungent taste, and should emit a trace of oil when pressed between fingers. It is a native of Moluccas and thrives in a moist tropical climate preferably in an island. It has been cultivated in southern India in the Government gardens, Burliar, and central Travancore, especially in Koni, with some success. It is likely to do well in similar places. It requires certain amount of sand in the soil to reduce its tenacity. The tree naturally likes a volcanic soil and a sloping position. It is

used in medicine in dentistry and is also in demand in the indigenous systems of medicine. It is largely used as condiment and for other household purposes. There is a very large demand in India.

12. *Ferula alliacea* Boiss. Syn. *F. Assa-foetida* Boiss et Buhse (non Linn.) — Asafoetida—Oleo-resin obtained by incision from living rhizomes of the plant.

The plant is found in eastern Iran and in Khorasan. It grows on stony arid soil up to an altitude of 7,000 ft. It might be successfully cultivated in India on the hills of North-West Frontier Province. It yields the kind of *hing* much preferred as condiment in India, and is used in the indigenous systems of medicine for a variety of purposes such as, stimulant, carminative, and antispasmodic and in hysteria, etc., There is a large demand for it.

13. *F. foetida* Regel. (Asafoetida)—Oleo-resin obtained by incision from living rhizomes of the plant.

The plant grows in southern Turkestan and in sandy deserts and arid hills of Eastern Iran, in Khorasan, and in the neighbouring parts of Afghanistan near Herat. Its cultivation may be tried in similar areas as in the case of No. 12 at an altitude between 2,000 to 4,000 ft. in the valleys. This is the asafoetida of European commerce and is used in medicine as sedative in hysterical conditions, as a carminative, and by mouth and enema in tympanitis. There is a sufficiently large demand.

14. *Gaultheria procumbens* Linn. (Gaultheria, Wintergreen)—Leaves for distillation of oil.

The plant is a native of America. It is likely to grow well in Nilgiris, Travancore, and Assam between 4,000 to 7,000 ft. in somewhat moist and shady places. There is a fair demand and it is used in rheumatism and neuralgia as an embrocation.

15. *Gentiana lutea* Linn. (Yellow Gentian)—Roots.

This plant is a native of alpine and sub-alpine regions of south Europe. It may well be tried in the temperate Himalayas at an altitude of 5,000 to 9,000 ft. There is a fairly large demand and it is used as a stomachic and bitter tonic.

16. *Glycyrrhiza glabra* Linn. (Liquorice)—Decorticated root, subterranean stem.

It is a plant of Mediterranean region and is cultivated in Italy, France, Russia, Germany, Spain, China, etc. It is known to be grown in Kochla Thana in Baluchistan, Drosh in Chitral and recently experimentally grown at the Agricultural College, Lyallpur. The areas where its cultivation may be successful are the temperate regions of the Himalayas and it may also do well in the hill districts of South India. There is a large demand for this drug. It is largely used in both western and indigenous systems of medicine and is used as a tonic, laxative and for cough.

17. *Hyoscyamus niger* Linn. (Henbane, Hyoscyamus)—Leaves and green tops.

Grows wild in India and does well in the north-west temperate Himalayas at an altitude between 5,000 to 9,000 ft. There is a moderate demand for it for medicinal purposes. It is used as a sedative and hypnotic. It is also used in the indigenous systems of medicine.

18. *Ipomoea purga* Hayne. (Jalap)—Tubers.

It is a native of the Mexican Andes, occurring at altitudes between 5,000 to 8,000 ft. In the localities where it grows rain falls almost daily, and the diurnal temperature varies from 60° to 70° F. It flourishes in shady woods in a deep rich vegetable soil and is now being cultivated in Europe. The plant has been grown in the Nilgiris and would do well in south Indian Hills and eastern Himalayas at an elevation of 3,000 to 6,000 ft. At higher levels the tubers are liable to be destroyed in winter unless protected from frost. There is a fair demand in India as a mild purgative.

19. *Lavendula spica* Cav. (Lavender)—Fresh flowering tops for distillation of volatile oil.

For places recommended for cultivation—See No. 20.

20. *L. vera* DC. (Syn. *L. Officinalis* Chaix) (Lavender)—Fresh flowering tops for distillation of volatile oil.

It is a native of south Europe and Mediterranean shores, extending into western Africa. It is extensively cultivated in England. It was tried in the Government Botanic Garden, Nilgiris, but proved a commercial failure. There seems no reason why it should not do well on the temperate regions of the Himalayas. When about four years old it yields the best otto, and is said to be improved by keeping back the flowering. Both Nos. 19 and 20 are used in medicine as flavouring agents and as carminative but there is a large demand in perfumery.

21. *Lobelia inflata* Linn. (Lobelia)—Dried aerial parts.

This is an American species and may well be tried in the Nilgiris and Travancore between 3,000 to 7,000 ft. It may also do well in the eastern Himalayas. There is a moderate demand in medicine. It is used as an antispasmodic in asthma and whooping cough and as an expectorant.

22. *Mentha piperita* Linn. (Peppermint)—Herb or better, perhaps, leaves during budding and flowering stages for distillation of volatile oil and manufacture of menthol.

The plant is largely cultivated in some foreign countries, *e.g.*, United States of America and England. Experiments were carried out many years ago with a certain degree of success in the Nilgiri gardens. Methods of planting, cultivating, harvesting and distilling have been worked out through years of trial and experiment in other countries and could easily be taken advantage of in India

It can be easily grown as a garden plant in temperate climate. According to a recent report by the Ministry of Agriculture, London, any light calcereous soil, friable sandy loams or gravels may be used for cultivation of mint. It is used as a carminative and to disguise the taste of evil smelling and unpleasant drugs. As a flavour in confections and dentifrices and other household purposes also it is used to a very large extent.

Japanese oil which is prepared from other species of Mentha—*M. arvensis* Linn. (var. *piperascens* Holmes) or from *M. canadensis* Linn. (var. *piperascens* Briquet) is also largely imported but is admittedly inferior to the English. The Japanese oil, however, is rich in menthol content. The future of the cultivation will depend upon the rate at which the synthetic menthol is being produced and boomed in the market.

23. *Myristica fragrans* Houtt. (Nutmeg, Mace)—Nuts, aril.

The plant is found wild in Moluccas. It is cultivated in India to a very limited extent and did well in the Government Gardens of Burliar in the Coonoor Valley on the eastern side of the Nilgiris and Courtallum hills further south. The best soil for the nutmeg tree is a deep rich loam with good drainage; the climate should be hot and moist. It is likely to grow well near the sea both on the East and the West Coasts of South India, especially the latter. It is not much used in medicine but the volatile oil enters into several important and widely pharmacopoeial preparations, and is also used in indigenous systems of medicine as stimulant, carminative and tonic, etc. It is extensively used in perfumery. It has a widespread use as a condiment in India and in European cookery.

24. *Myroxylon toluiferum* H. B. and K. (Tolu)—Balsam obtained from incision of bark.

It is a plant of tropical America and may do well in south India and eastern Himalayas at places with fairly equable temperatures and at altitudes between 1,500 to 3,000 ft. It is used for flavouring and improving the taste of liquid medicines. It has a large demand in medicine.

25. *Physostigma venenosum* Balf. (Physostigma)—Seeds.

This is a plant of tropical Africa and in India it may be tried in the plains of several provinces. It has a moderate demand in medicine as a myotic and is also used to increase gastric and intestinal peristalsis.

26. *Piper cubeba* Linn. f. (Cubebs)—Dried full grown, unripe fruits.

It is a native of Java and the Moluccas, and has been successfully cultivated in Mysore. The plant grows well up to an altitude of 1,500 ft. and likes a warm and moderately moist climate. It will probably do better in South India and may do well in certain parts of Bengal. It has a moderate demand in medicine as a urinary antiseptic, but there is a fairly large demand in indigenous systems of medicine. There is also some demand as a spice.

27. **Plantago ovata* Forsk. (Isapghul) } Seeds.
28. *P. psyllium* Linn. (Psyllium) }

These two plants would do very well in the plains and hills throughout India up to an altitude of 6,000 ft. or so, preference being given to places with not too high rainfall. No. 27 is used to a large extent as a household remedy in dysentery and diarrhoea and for functional derangement of digestive organs. No. 28 has recently come into use as a popular laxative and demulcent in foreign countries.

29. *Polygala senega* Linn. (Senega)—Roots.

It is not a native of India nor is cultivated here. It may be tried in the temperate Himalayas at 4,000 to 7,000 ft. and it may do well at somewhat lower altitudes also. Places with too much rainfall are not suitable. There is a small demand for this drug in medicine as an expectorant.

30. *Psychotria ipecacuanha* Stokes. (Ipecac)—Roots.

The plant has so far been cultivated in India at Mungpoo in Bengal and at Burliar and Kallar gardens in south India and at Mergui in Burma. Everywhere the plant thrived well but specially so in Burma where it was put on river silt. The climate suitable for cinchona also suits this plant. It may be tried in eastern Himalayas at places where variations in temperature are small and where land might be had along the river banks. There is large demand for amoebic dysentery and as an expectorant.

31. *Rhamnus purshiana* DC. (Cascara sagrada)—Bark.

It is likely to do well in the temperate Himalayas with moderate or even low rainfall. There is a large demand in medicine as a purgative.

32. *Rosa centifolia* Linn. (Hundred leaved or Cabbage rose) } Flowers.
33. *R. damascena* Mill. (Damask or Persian rose) }

Both these species are cultivated in gardens all over India but No. 32 is, at any rate, the more common. Plains of northern India are most suitable and places with slightly sandy soil are preferred. There are some places for example, Patna, Ghazipore and selected areas in the Punjab, where it is known to do very well and large areas are covered with it. Cultivation on a larger scale would be a paying proposition. Rose water is used in medicine as a flavouring agent. The petals or the rose water is also used in the indigenous systems of medicine. There is a very large demand in commerce for the preparation of oil or otto and rose water.

34. *Rosmarinus officinalis* Linn. (Rosemary)—Fresh flowering tops for volatile oil.

It is a plant of the Mediterranean region and is reported to be cultivated in the gardens in India. It may be tried in the plains with equable climate but is likely to do better in the temperate Himalayas with dry to moderately moist

* Those marked with asterisk are used only in the indigenous systems of medicine.

climate. Preparations of Rosemary are chiefly employed externally as ingredients of stimulating liniments. It is also employed as an adjunct in many perfumes, *e.g.* Hungary water and Eu-de-Cologne.

35. **Saussurea Lappa* C. B. Clarke (Costus, Kuth)—Roots.

The plant naturally occurs on the moist, open slopes, surrounding the valley of Kashmir and in parts of basins of the Chenab and the Jhelum. It is being cultivated to some extent in the village Koksar in Upper Chandra valley in the Punjab. Cultivation on a large scale could be started in the western Himalayas at an altitude between 8,000 to 10,000 ft. It is likely to be one of the most paying crops. It is used in asthma and in preparations of stimulating ointments. Its use as a protector of warm clothes from attacks of moth and other vermins is well known. It is exported in enormous quantity to China, where it is used as incense. Three to four years' old roots are marketed.

36. *Strophanthus kombe* Oliver (Strophanthus)—Seeds.

It is an African species and is likely to do well in the moist tropical regions of south India. It is possible that it may do well in drier places also. There is a fair demand. It is used to increase the tone, excitability and contractility of cardiac muscles.

37. *Styrax benzoin* Dryand (Benzoin)—Balsamic resin obtained from incised stem.

The plant has been known to be successfully grown in the Government Gardens, Bangalore. It will probably do well in several other places in south India. It is used as an inhalent in chronic inflammation of mucous membrane (bronchitis) and as an antiseptic for cuts and wounds. There is a fairly large demand.

38. **Swertia chirata* Ham (Chirata)—Whole plant.

It grows very well in the temperate Himalayas between 4,000 to 7,000 ft. It is used as a bitter and stomachic and there is a fair demand.

39. *Uriginea scilla* Steinheil (Squill)—Bulbs. (Syn. *U. maritima* Baker).

This plant grows on the shores of the Mediterranean. It may be tried in places where Indian scillas grow, that is, in sandy soil near the sea or in the drier hills of the lower Himalayas up to an altitude of about 3,000 ft. There is a fair demand. It is used in medicine as an expectorant and general diuretic.

40. **Viola odorata* Linn. (Sweet violet)—Flowers (also the whole herb).

It can be grown in the plains but more suitable situation would be the temperate Himalayas and Nilgiris between 3,000 and 6,000 ft. Places with drier climate should be preferred. There is a large demand in the indigenous systems of medicine for a variety of purposes such as, astringent, demulcent, diaphoretic, diuretic and in biliousness and lung troubles. Very little of the genuine stuff is available in the market.

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* Those marked with asterisk are used only in the indigenous systems of medicine

INSECTS IN RELATION TO DISEASE OF DOMESTICATED ANIMALS*

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Introduction

The customary precedence given by the average individual to the curative aspect of disease control over the science of preventive medicine and prophylaxis constitutes a remarkable instance where the normal sequence of human endeavours is designedly altered in the conviction that such a course makes for expediency in the matter of ensuring a better standard of health and efficiency. While in every other field of his conflict with the elements of nature, the human subject has garnered the fruits of his age-long experience in the numerous forms of protective device that have time and again served as bulwark against their aggression, it is in the field of disease alone affecting either himself or his live-stock that he frequently betrays a curious lack of foresight and defensive instinct and diverts the bulk of his efforts to fighting the enemy when it has already crossed his unguarded portals of entry and has even succeeded in making an inroad into the very interior. One thus notices the hapless stock-owner making frantic efforts to get his animal rid of this or that disease ' germ ' that has unaccountably invaded its circulating blood or of an army of fly maggots that have, in a mysterious fashion made their appearance in an unsightly wound in its skin. Is he really so powerless, as he thinks himself to be, to prevent such aggression and is it merely given to him to be a silent witness to the damage that is being wrought and then to arrest its progress or repair it as best he can ? A reply in an emphatic negative was provided to this question when, in 1796, Jenner laid the foundation of the present-day preventive medicine by demonstrating the value of vaccination against small-pox. The principles of so-called ' jennerization ' have been extended to cover a wide field in both human and veterinary medicine, for, as is well known, the use of anti-sera and vaccines now constitutes a potent method for combating a number of diseases affecting man and animals. While the introduction of these products has thus registered a definite advance in the history of preventive medicine, one is apt to lose sight of the precise significance of their protective value : they are not designed to ward off a disease-producing organism, but to prevent it from obtaining a foothold in the system of its host. The form of treatment envisaged

*This is the ninth of a series of p pular articles for practical farmers on various animal husbandry subjects of general interest.

in this method may thus be designated as "neo-therapy", being in essence, a form of curative treatment, having as its objective the annihilation of the disease-organism before the latter has had time to proliferate and overpower its victim. Curiously, the advantages of even this simple "nip in the bud" method, although obvious enough, do not, as yet, appear to have received their due share of recognition, and one notices that the craze for nostrums continues unabated, not only amongst the masses, but also amongst the intelligentsia, whose acquaintanceship with such products is not infrequently regarded as a measure of the extent to which they have succeeded in keeping themselves abreast of the more recent advances in the science of medicine.

In so far as veterinary medicine is concerned, however, the cult of "healing art" has never been viewed with the same degree of favour as it has been in human medicine, for the bulk of the work in this field has been directed to perfecting methods of prevention, so that in this respect it must be regarded as the more rationalistic of the two in its outlook. How this has come to be so is not far to seek, for, as Fleming has remarked, "the medicine of the lower animals differs from that of man in no particular so much perhaps, as in the application it makes of utilitarian principles. The life of the man is sacred; but in the case of animals where there are doubts as to complete restoration to health and soundness, monetary considerations generally decide against the adoption of remedial measures". The science of disease prevention, as opposed to disease cure, thus constitutes the very essence of veterinary medicine and assumes a paramount position for the stock-owner whose concern for his animals is not so much dominated by ethical principles as by considerations of efficiency and usefulness. As already indicated in this note, this science largely consists, at the present time, in the application of products designed to destroy the disease organisms before they have obtained a foothold in the tissues of their hosts, so that the millenium would be reached if measures could be devised to prevent live-stock from acquiring them at all. This brings us to a consideration of the mechanism whereby such organisms are acquired.

How disease-producing organisms are acquired by live-stock

It is now a well-established fact that a great many of the parasitic and also a proportion of the virus diseases are transmitted through the agency of insects or ticks, and this is why, as remarked by Rosenau [1927], "Entomology has become a vitally important subject so far as preventive medicine is concerned". It has been computed that about one hundred diseases of live-stock are transmitted in this manner, and as has been pointed out elsewhere by the present writer [Sen, 1934], the actual number of such diseases is likely to turn out to be far greater, in view of the fact that the avenues of infection are numerous in the case of animals on account of the unprotected manner in which they are maintained.

In the present note, it is proposed to deal with only such common diseases

of live-stock as are known or suspected to be transmitted by insects, for the subject of tick-borne diseases has now attained a dimension sufficiently large to merit separate treatment and will therefore be dealt with in a later communication. For the information of readers not possessing an acquaintanceship with Systematic Entomology, it may be mentioned that an insect is characterized by the possession of three pairs of legs in the adult stage and by the body being divided into three well-marked regions, namely, the head, thorax and abdomen. An adult tick, on the other hand, possesses four pairs of legs, whilst the head and the thorax are fused to form what is known as the cephalothorax (Plate XVIII)

The methods by which diseases are transmitted by insects may be classed into two broad categories: (1) mechanical and (2) cyclical. In the first method, the insect merely plays the part of a casual porter and carries the disease-producing organism on its mouth-parts or legs (Plate XVIII)—both of which are well adapted for this purpose—or other parts of its body and deposits it on wounds or abrasions or on the mucous membrane of a healthy animal; or, the organism may be directly inoculated by means of its mouth-parts, exactly in the same way as one would do in giving an infective inoculation by means of a needle, so that, in this last sense, all blood-sucking insects may be regarded as potential carriers of disease. The organism may also obtain a temporary lodgment in the upper part of the digestive tract of the insect and the latter may regurgitate it, while feeding, on the body of the final host; or, the organism may pass through the digestive tract and be voided in the faeces; or, again, it may not normally pass out of the insect at all but may be acquired by the animal by the crushing or swallowing of the insect.

Under natural conditions, a common method of disease transmission is by the so-called "interrupted" feeding, where the infective insect, while engaged in the act of obtaining a meal of blood, is interrupted by the movement of the host and at once proceeds to complete the feed on a healthy animal of the same species. Similar conditions have been actually reproduced in the laboratory in order to test the possibility of certain diseases being transmitted in this manner, and in a proportion of these trials the results have been positive.

In the cyclical method of disease transmission, on the other hand, the causal organism, after being ingested by the insect vector, undergoes a series of developmental changes before it becomes again infective for a new host, as is known to be the case in the mosquito transmission of human malaria. It has, however, been repeatedly observed that such development is capable of being accomplished by an organism only in one or a very limited number of insect species, and it is the discovery of the actual species of vectors thus involved that constitutes one of the principal aims of research in both Medical and Veterinary Entomology. It will be readily realized that progress in this field is necessarily slow, inasmuch as it entails an intensive examination of the internal tissues of suspected vectors and the

prosecution of carefully controlled transmission experiments, and all this frequently assumes enormous proportions. This is why the bulk of the existing knowledge concerning insect vectors of animal diseases relates to the mechanical, as opposed to the cyclical, method of transmission, and it will also be largely the former category of diseases that will be dealt with in the section that follows.

SOME COMMON INSECT-BORNE DISEASES OF LIVE-STOCK

It would hardly be possible within the compass of a note of this kind to deal, even in outline, with the whole of the enromous volume of accumulated evidence on record pointing to the conclusion that it is through the intermediary of insects that a large proportion of the pathogenic organisms are acquired by live-stock. In what follows it is proposed merely to cite, by way of illustration, a few of the more important diseases in which insect vectors are known or believed to be involved. For the sake of convenience, these diseases will be considered under four categories, depending upon the nature of the agents responsible for their causation and this will incidentally furnish an indication of the remarkably varied character of the rôle played by insects in their spread under natural conditions.[1]

(a) Virus diseases[2]

1. *Rinderpest.*—There is on record a good deal of presumptive evidence to indicate that this most serious contagious disease of cattle is spread through the intermediary of blood-sucking flies. The consistency with which the disease can be reproduced by the sub-inoculation of a minute quantity of infective blood is in itself suggestive of such a possibility and to this may be added the observations brought forward by some recent workers to show that outbreaks of rinderpest frequently synchronize with the seasonal occurrence of the larger types of biting flies [Crawford, 1933]. As a matter of fact, there are instances on record where the disease has been experimentally reproduced through the bites of tsetse flies in Africa [Hornby, 1926] and of horseflies in India [Bhatia, 1935].

2. *Fowl-pox.*—This is one of the few virus diseases which have been conclusively shown to be capable of being transmitted through the agency of insects. It has been recently demonstrated that under experimental conditions fowl-pox can be readily reproduced through the bites of various species of mosquitos, some of which are of common occurrence in India [Kligler, Mackenfuss and Rivers, 1929]. In a few instances, these mosquitos have been found to remain infective for about a fortnight following a meal on diseased fowls. It is noteworthy that the stable-fly has also proved capable of transmitting fowl-pox one to fifteen days after becoming infective [Bos, 1932].

(b) Bacterial diseases

3. *Anthrax.*—The earliest experimental evidence of the transmission of anthrax through the agency of insects was obtained as far back as in the year 1869,

[1] The general features of the vectors mentioned in this and the following section are indicated by diagrammatic sketches in Plate XVIII.

[2] These diseases are caused by agents which cannot be seen under the microscope.

when Raimbert showed that the disease could be reproduced by the inoculation into guinea-pigs of the crushed bodies of meat flies that had been fed on anthrax blood. Since that date, our knowledge of vectors concerned in the spread of this disease has steadily advanced, and of the more recent contributions in this field, mention may be made of those made by Morris [1918] in America, who succeeded in transmitting the disease through the agency of horseflies and mosquitos. The so-called carrion flies are also known to be not infrequently concerned in the spread of the disease under natural conditions, and this is only what is to be expected in view of their habit of breeding in carcases of animals, including those dead of anthrax. This was strikingly illustrated during the Great War when numerous cases of the disease occurred in animal subjects due to flies bred from infected carcases on the battlefield.

4. *Haemorrhagic septicaemia.*—Although no definite experimental evidence has as yet been put forward to prove the transmission of this disease through the agency of insects, there is a considerable amount of presumptive evidence on record pointing to the conclusion that, under natural conditions, the disease is conveyed by more than one species of biting flies, notably horseflies [Nieschulz and Kraneveld, 1929]. In view of the fact that the causal parasite of haemorrhagic septicaemia is a near relative of the bacillus of human plague, the possibility suggests itself, as already pointed out by Sen [1925], that fleas may also act as vectors of the disease.

(c) *Protozoan diseases*[1]

5. *Surra* (Trypanosoma evansi *infection*).—In relation to the question of vectors of animal diseases, the subject of surra has received by far the largest amount of attention from veterinary workers in India, the earliest observations in this field having been made as far back as in the year 1901, when Rogers brought forward some experimental evidence to prove that the disease was transmitted by the bites of horseflies. Rogers's observations have since been confirmed by a large number of other workers, not only in India, but also in the Philippines [Mitzmain, 1913] and Dutch East Indies [Nieschulz, 1930]. Of the Indian workers in this field, a special mention should be made of Cross and his collaborators [1922, 1923], who, as a result of an extensive series of experiments, came to the conclusion that the disease was capable of being transmitted by several species of horseflies, notably the one known as *Tabanus rubidus*, which is of very common occurrence in this country. At the present time, however, attention has been largely focussed on the possibility of the occurrence of a cyclical transmission of the disease on the analogy of what is known to take place in the

[1] The protozoa are ' unicellular ' organisms and include the malaria parasites.

case of a similar condition (Nagana) in Africa, although the indications so far available would appear to be against this possibility.

6. *Pigeon malaria.*—This disease, although of less importance than the preceding ones, provides a feature of special interest in that it represents the only instance of an insect-borne protozoan disease of live-stock in India where the causal parasite (*Haemoproteus columbae*) is definitely known to undergo a cyclical development in its invertebrate host, which is a well-known louse-fly (*Pseudolynchia maura*) and is of common occurrence on pigeons in the plains of India. The development undergone by the parasite in the fly occupies a period of about three weeks, and at the end of this period, but not before, the fly becomes infective for healthy birds [Adie, 1924].

(*d*) *Worm diseases*

7. *Bursati.*—This well-known equine disease, which manifests itself in the form of tumours, has recently been shown [Datta, 1933] to be caused by a species of worm (*Habronema*), which is either identical with or closely allied to the parasite responsible for an analogous condition, known as summer sores, in certain other parts of the world. It has been conclusively demonstrated that the causal parasite of this latter disease is transmitted by both the housefly and the stablefly in which it undergoes changes before becoming again infective for a healthy subject, so that it is more than probable that the same two vectors are also concerned in the production of *bursati* in India. In the final phase of its development in the tissues of its invertebrate host, the parasite invades the mouth-parts where it usually remains in residence until excited to activity by contact with a warm, moist surface, such as what occurs when the fly is sucking moisture from the horse, and under such conditions, it actively leaves the proboscis of the fly and invades the equine host.

8. *Tapeworm of dogs.*—This worm (*Dipylidium caninum*), which occurs commonly in the intestines of dogs and cats, is transmitted by the biting dog-louse (*Trichodectes canis*) and also by dog-fleas (*Ctenocephalus felis* and *Ct. canis*). The eggs of this worm are passed through the dog's anus and fall to the ground, when they are ingested by the flea larva. They now hatch into embryo tapeworms and these latter eventually develop into the so-called 'cysticercoid' forms. By this time the flea larva develops into the adult stage and it is by swallowing the infected adult flea that the dog or the cat, as the case may be, acquires the infection. A similar cycle of development also takes place in the dog-louse.

Before concluding this section, a reference should be made to a group of diseases in which insects do not play the rôle of transmitting agents, as they do in the instances cited above, but inflict direct injury on the host, which, in consequence, may develop extreme unthriftiness and other symptoms indicative of a general loss of condition. Examples of this are provided by the so-called "lousiness" caused by a massive infestation of lice, and "myiasis", a term given

to the conditions brought about as a result of invasion by fly maggots of the skin, digestive tract, or rhinal and other passages of man and animals. As is well known to most stock-owners, such maggots, when present in large numbers in wounds or sores, may cause extensive injury by burrowing into the tissues. In this connection, it is worthy of note that the Indian bluebottle, *Chrysomyia bezziana*, has, unlike most other species of this class, the peculiar habit of breeding only in living tissues, instead of in carcases, and this accounts for the fact that it happens to be the commonest species of myiasis-producing fly in this country. By far the most important form of animal myiasis, however, is that caused by the ox warble fly (*Hypoderma lineatum*) and this has already been dealt with by the present writer [Sen, 1934, 2] in a previous article in this Journal.

Combating disease-carrying insects

The subject of combative measures against blood-sucking insects, as adopted in some of the progressive countries of the world, has already been dealt with elsewhere by the present writer [Sen, 1932]. Moreover, a consideration of these measures would be outside the scope of this paper, for, as its title indicates, its object is no more than to present facts illustrative of the importance of insects as carriers of some of the common diseases of domesticated animals in India. It would seem, however, that in relation to the general problem of combating the insect pests of live-stock, these facts might be relevantly elaborated to include an outline of the life-history of the insect vectors referred to in the preceding section, for it is on this knowledge that any rational method of control will have to be ultimately based, and, as pointed out by Rosenau [1927], "without an acquaintance of the life-history and habits of the insect host, there will be economic loss, wasted energy and disappointing results".

By far the largest majority of insects with which the stock-owner is concerned have, broadly speaking, the same type of life-history, their growth being marked by a series of remarkable developmental changes from the egg to the adult stage which are expressed by the term 'metamorphosis'. This is best illustrated in the case of a horsefly (Plate XIX). It lays eggs on vegetation overhanging water and these hatch into larvae which live an aquatic life, feeding and growing all this time (which may be several months), until they enter a quiescent stage and turn into pupae and these latter, after a period of about a month or more, transform into winged adults. The occurrence of these four stages—the egg, larva, pupa and adult—also forms an essential feature in the development of the mosquito, house-fly, buffalo-gnat and, in fact, of most species of flies and also of the flea, although a considerable amount of variation may exist in regard to their breeding habits. Thus, the housefly breeds largely in horse-dung and kitchen refuse, the stablefly in stable litter impregnated with urine, the bluebottle in carrion, the mosquito in accumulations of water, the sandfly in various kinds of earth materials, the buffalo-gnat in running streams and the flea in crevices of floors and under mattings

in places frequented by dogs and cats. How a knowledge of the breeding habits of these insects is capable of being utilized in combating them is illustrated by the well known method of destroying mosquito larvae in water by the application of kerosine oil or Paris Green. On such knowledge also are based the principles of sanitation which enjoin the effective disposal of manure and carcases in order to prevent the breeding of houseflies and bluebottles respectively. In the case of horseflies, again, one realizes that organized campaigns directed to destroying their egg-clusters are likely to prove of very appreciable value in combating these pests, for a single cluster may contain hundreds of eggs.

The type of life-history described above, however, does not apply to the members of the families to which the bed-bug and the louse belong. In the case of these insects, the eggs hatch into young which do not differ in appearance from their parents except for their smaller size and for the fact that the genitalia are not patent. Later, the genitalia develop and the insects grow in size and attain the adult state. Although the bed-bug and the louse thus present a similarity in so far as their life-history is concerned, their habits of breeding, however, are entirely different. While, as is well known, the bed-bug commonly lives in cracks and crevices of buildings and furniture, the louse, on the other hand, cannot live for any great length of time if apart from its host, on which, in fact, it accomplishes its entire life-cycle. Combative measures against bed-bugs, therefore, frequently take the form of fumigation of infested houses, while those against lice usually consist in the application, directly on the body of the host, of various insecticides, such as sodium fluoride in the case of birds, and of raw linseed oil or a combination of tobacco decoction and cresol in the case of mammals.

Finally, a very curious type of life-history characterizes *Pseudolynchia maura*, the transmitter of pigeon malaria (*ante*), and certain other related flies. These deposit full-grown larvae which pupate shortly after extrusion, so that, in such cases, the use of traps against the adult flies is calculated to yield the largest measure of success.

In formulating combative measures against insects, it is useful to remember that one is reckoning with a type of enemy which, in numerical strength, is by far the most formidable in the animal kingdom, for a total of nearly 500,000 species of insects have already been described and they represent seven-tenths of the known species of all kinds of animals. The number of known species of horse-flies alone has been estimated at more than 2,000 and that of biting lice at nearly 1,700. The power of flight and concealment possessed by most species of insects and the amazing rate at which some of them can multiply are further points in their favour. Thus, a housefly may lay more than 2,000 eggs in one month's time, and at a temperature of about 30°C. The approximate duration of the egg, larval and pupal stage has been found to be twelve hours, six and five days respectively, so that the time required for development from the egg to the adult is less than

twelve days. It has been estimated by Hodge [1911] that "a pai of flies beginning operations in April might be the progenitors, if all were to live, of 191,010,000,000,000,000,000, flies by August. Allowing one-eighth of a cubic inch to a fly, this number would cover the earth forty-seven feet deep".

In practice, the combative measures aganist disease-carrying flies are frequently directed to exterminating them in the adult stage, as is witnessed by the numerous forms of traps and repellents at present in use to achieve this end. For reasons indicated in the preceding paragraph, however, the application of these measures can only yield results of a very limited value, and experience has shown that it is only by striking at the source, namely, at their bre ding media, that a reduction in their number can be effected in an appreciable manner. These media however, are not only of an extremely varied character but are scattered over such extensive areas as to demand the closest co-operation between stock-owners and the general public for their effective disposal, and it is almost needless to say that the urge for such co-operation can only originate from a realization of the magnitude of the problem and the inestimable benefits that are likely to accrue from endeavours directed to solving it on rational lines. The immediate desideratum in this connection is to assist the stock-owner in the appreciation of the fact that it is as paradoxical to wage a continuous war against insect-borne diseases without taking any notice of the vectors themselves, as it would be to embark upon a scheme of devising methods for combating incendiarism without having anything to do with the habitual incendiary.

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EXPLANATION OF PLATES

PLATE XVIII

Diagrammatic sketches to indicate the general features of some common insect vectors injurious to live-stock. The first two figures are those of ticks and are included here to indicate the difference between an insect and a tick. (Drawings not made to any scale.)

FIG. 1. A "soft" tick (Argasid).

FIG. 2. A "hard" tick (Ixodid).

FIG. 3. A sandfly (*Phlebotomus* sp.).

FIG. 4. A buffalo-gnat (*Simulium* sp.).

FIG. 5. A stablefly (*Stomoxys* sp.).

FIG. 6. A maggot from wound.

FIG. 7. The louse-fly, *Pseudolynchia maura*, the vector of pigeon malaria.

FIG. 8. A flea (*Ctenocephalus* sp.).

FIG. 9. A sucking louse (*Haematopinus*).

FIG. 10. A biting louse (*Trichodectes* sp.).

FIG. 11. The head and mouth-parts of the housefly.

FIG. 12. The foot of the housefly.

FIG. 13. Mouth-parts of a horsefly.

FIG. 14. Mouth-parts of a stablefly showing worms of summer sores (see p. 9). (After Hill, 1918.)

PLATE XIX

Life-history of a horsefly (*Tabanus* sp.), a common vector of surra.

FIG. 1. Cluster of eggs on under surface of leaf (slightly magnified).

FIG. 2. Ditto, removed from leaf. × 4½.

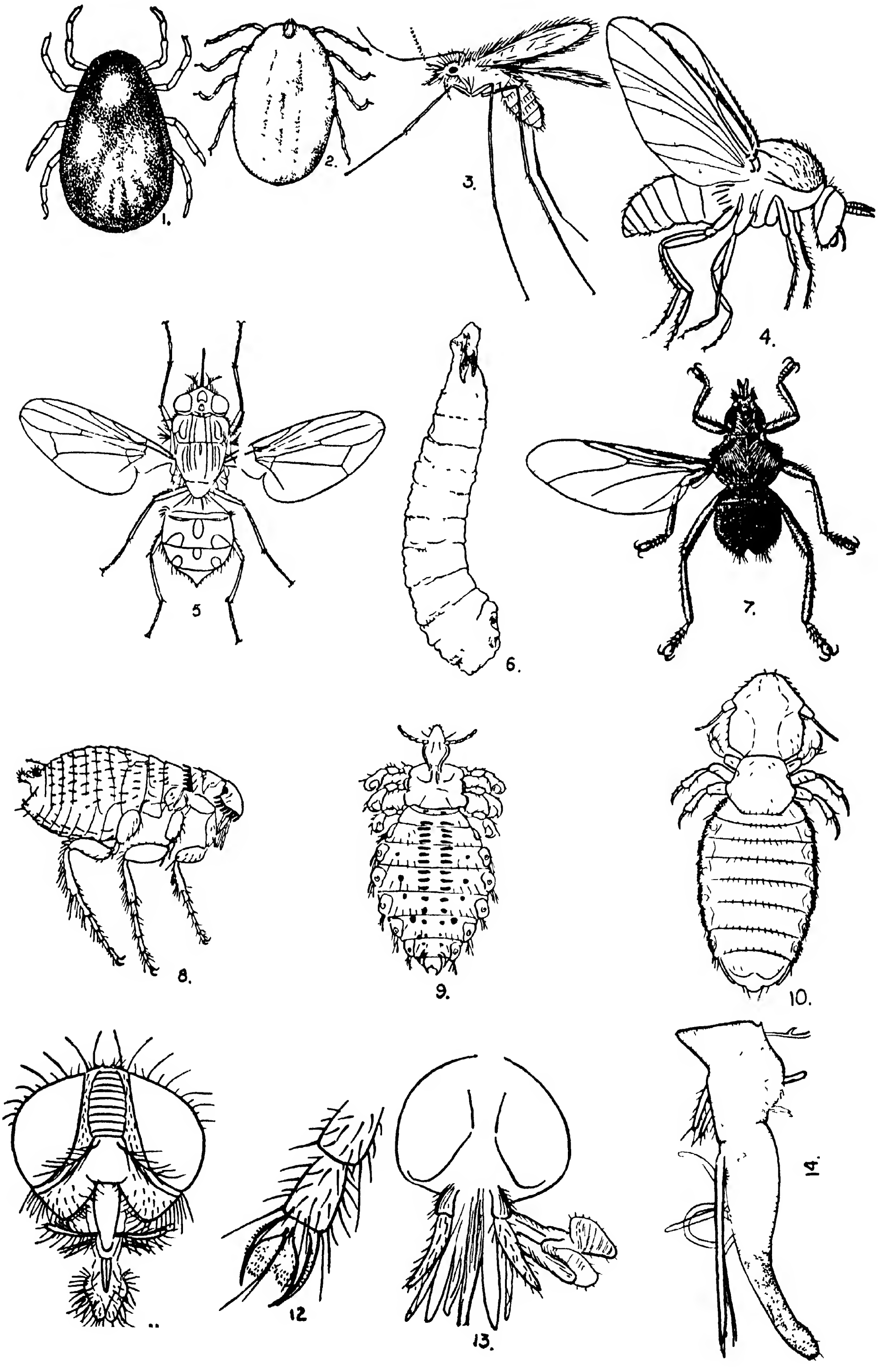
FIG. 3. Larva. × 4½.

FIG. 4. Pupa. × 4½.

FIG. 5. Adult. × 4½.

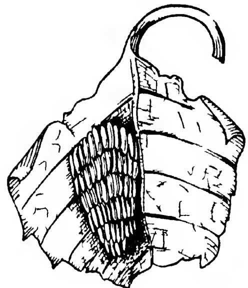
FIG. 6. Three surra parasites with some blood corpuscles (highly magnified).

PLATE XVIII



[*For explanation see p.* 244.

LIFE HISTORY OF A HORSEFLY (*TABANUS* SP.)



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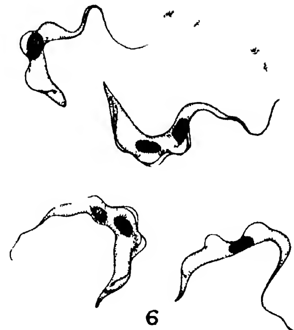

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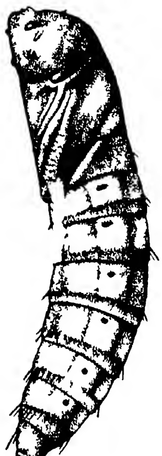

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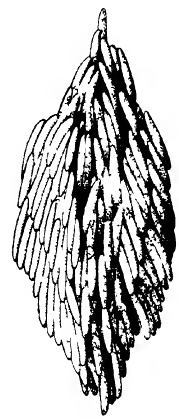

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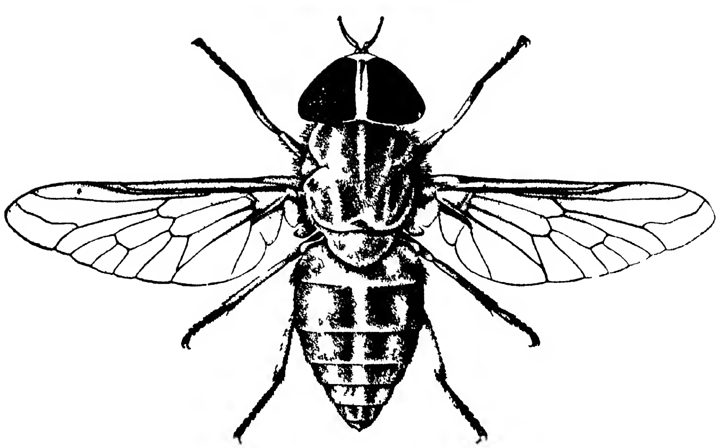

5

IMPROVED PUSA OATS FOR FODDER PRODUCTION

BY

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THE problem of providing suitable fodder and forage to the cattle population of India is as important as it is intricate. It is one of the main limiting factors in all schemes of cattle improvement. Good pastures are not readily available in this country and intensive methods of cultivating fodder crops are the exception. The demand for larger fodder production from urban as well as rural areas is on the increase and its importance cannot be over-emphasized.

The introduction of higher yielding varieties of food crops such as wheat, barley, rice, etc., has resulted in a proportionate increase in the available dry fodder but much remains to be done in evolving suitable crops mainly for the cattle. The agricultural departments all over India have this problem before them and interesting and useful investigations are in progress in improving crops like sorghum, maize, etc., by selection or hybridization, as well as in the introduction and acclimatization of lucerne, berseem, elephant grass, guinea grass and other grasses.

Oats may be considered a good fodder crop for horses and cattle because of their high nutritive value as well as the adaptability of the crop to a wide range of soil and climatic conditions. Oats can be fed to cattle in almost all stages of the plant's growth. In the young or green condition it yields profuse and first class green fodder. The dry straw (or hay) is readily eaten by animals. The seed serves as a valuable and important ration, largely used in dairy farms and military cantonments as one of the chief constituents of the concentrates recommended for animals. The value of oats as a fodder crop, however, is not yet sufficiently widely recognized in this country, and the purpose of this paper is to invite attention of the people concerned to the value of this important crop.

Selection, acclimatization and hybridization have all received their due share of attention with this important crop at Pusa [Shaw and Bose, 1933] and a number of valuable types and hybrids have been secured as a result of these studies. The yield of grain of these improved oats usually averages from 1500 lbs. to 2500 lbs. per acre and that of straw is one and a half to twice the weight of grain obtained. A large number of European and American oats have been tried at Pusa but even the earliest spring oats amongst them proved to be too late for Indian climates. Many of them produced excellent green fodder, in considerable quantities, but they invariably failed to set a normal amount of seed. The final quality and yielding capacity of any strain is an effect largely attributable to its inherent characters as well as to the manner in which it can accommodate itself to the soil and climatic

conditions under which it is grown. It was useless, therefore, to continue the work of acclimatizing exotic oats and hybridization was resorted to. Some of these hybrids so produced, not only combine high-yielding power of grain with ample strong straw, but possess the added merit of maturing with less water than most of the exotic varieties—a fact which is of great advantage in a country where water-supply is the principal limiting factor in crop production.

To obtain the highest possible return from every acre of land is the aim of every cultivator and this can be achieved by growing good and reliable seed. The supriority of pedigree seed will manifest itself on whatever class of land it is grown and Pusa oats claim this property. There can be no better testimony to the worth of Pusa oats than that during the short space of less than a decade, thousands of maunds of Pusa oats are now being grown in India and that the insistant demand for these oats far exceeds the supply. Even the small local ryot is starting to cultivate Pusa oats for his cattle because of the attractive and valuable properties of the crop.

The main strains which are distributed on a large scale at present are :—

B. S. 1.—Early maturing type evolved from Bihar oats by selection. Plants, semi-erect in the early stage of growth, with moderate tillering capacity and weak straw. Leaves, long and fairly narrow with a few marginal hairs. Leaf-sheath, deep purple at the base. Panicle equilateral, more or less erect, yellowish green. Spikelets with thin awns and many short hairs on the callus, and *sterilis*—type of base. Grains dirty yellow with a greyish tinge on the tips of the glumes. High yielding, drought and smut resistant. Ideal for tracts with low rainfall. Bushel-weight thirty-five lbs.

B. S. 2.—Another selection from Bihar oats resembling B. S. 1 in all morphological characters but maturing about a fortnight later and rather more susceptible to smut.

Hybrid C.—An early-maturing oat obtained by hybridising B. S. 2 with Scotch potato oats. Plants spreading in the early stages of growth and having profuse tillering capacity and strong straw. Leaves long and broad with a few marginal hairs. Leaf-sheath, light purple at the base. Panicle, equilateral, more or less erect, somewhat bluish green. Spikelets, with thick awns and few short hairs on the callus and *sativa*-type of base. Grains, yellowish white, very plump. High-yielding and profuse-straw-producing oat. Very suitable for tracts with high rainfall or irrigated conditions. Smut resistant. Bushel-weight thirty-nine lbs.

Hybrid J.—Medium in maturity, obtained by hybridising B. S. 4 with Scotch potato oats. Plants spreading in the early stages of growth and having profuse tillering capacity and strong straw. Leaves, long and broad with numerous marginal hairs. Leaf-sheath light purple at the base. Panicle, equilateral, more or less erect, somewhat dull bluish green. Spikelets, with thin awns and many short hairs on the callus, and *sterilis*—type of base. Grains, bright yellow in colour,

very plump. High-yielding and profuse-straw-producing oat. Smut resistant. Bushel-weight thirty-six lbs.

Hybrids C and J shatter their grain a little if they are left too long in the field after maturity.

A large number of other hybrids having some well-known exotic oats such as the Orion, Abundance, Iowa, Kinwada, etc., as one of their parents, are in the experimental stage and will soon be released for distribution.

B. S. 1 and B. S. 2 have now stood the test of time and have maintained their reputation for high yields, early maturity and drought resistance. The following table shows the average yields of these two selections at Pusa [Shaw and Bose, 1933].

TABLE I

Average yields of B. S. 1 and B. S. 2 oats at the Botanical Section, Pusa, during the period 1929-33

Type	Average yields of grain in lbs. per acre					Average of five years in lbs. per acre
	1929	1930	1931	1932	1933	
B. S. 1 . . .	2,378	2,322	1,871	2,370	2,446	2,277·4 ±62·47
B. S. 2 . . .	2,878	1,870	1,960	2,617	1,815	2,228·0 ±131·09

The superiority of these oats over the previously cultivated varieties has led the Pusa authorities to reject the latter and to adopt the former as the standard oats on the Pusa Farm. Large areas are also being put under B. S. 1 oats at Karnal and many other Provincial Farms. Some of the local Bihar planters nowadays cultivate this strain on a large scale.

A number of yield trials have also been conducted. Eleven hybrids with Scotch potato oats were tried against B. S. 1 and B. S. 2 simultaneously at Pusa and Karnal for three consecutive years [Bose, 1935] and the average yields obtained in these two localities are presented below :—

TABLE II

Average yield of grain in Pusa oats in lbs. per acre, during the triennial period 1931-32 to 1933-34

Locality	Hybrids											B. S. 1	B S. 2
	A	B	C	D	E	F	G	H	I	J	K		
Pusa .	1,548·6	1,290·5	2,195·3	1,759·0	1,922·0	1,912·2	2,040·2	1,518·2	1,853·1	2,096·7	1,597·9	2,263·4	2,221·4
Karnal .	1,758·8	1,255·7	1,935·7	1,813·9	1,769·0	1,650·1	1,993·7	1,585·1	1,619·7	2,031·5	1,813·9	1,905·3	2,083·6

It will be evident from the above table that the five high yielders in the experiment were B. S. 2, B. S. 1, and Hybrids C, J and G in the order given, though the yields of B. S. 1 and Hybrids C, G and J were not found to be statistically different from each other. In these three hybrids, however, the high-yielding capacity of the Pusa parents have been combined with the plump grain, profuse straw and other good qualities of the Scotch Potato oats.

An idea of the production of straw in the hybrids and B. S. 1 and 2, mentioned above, may be formed from Table III where the comparative yields of dry straw, as obtained at Pusa in 1934, are tabulated.

In order to study the differences in the yields of green fodder, grain and of straw in two Pusa selections, seven Pusa hybrids and an exotic oat, *viz.*, Iowa, 103, a yield trial was conducted at the Botanical Sub-station,* Pusa during 1936-37. The experiment was laid out in randomized blocks, with five replications. The size of each sub-plot was one-fortieth of an acre, from half of which green oats taken at the right stage were cut, the other half being allowed to mature to seed. The results obtained are presented in Table IV.

*Financed by the Imperial Council of Agricultural Research.

TABLE III

Comparative yields of straw in oats at Pusa in 1934

(Barah I)

—	Yields of dry straw in lbs.											Types	
	Hybrids.												
	A	B	C	D	E	F	G	H	I	J	K	B S 1	B S 2
Yield per acre . .	2,903 71	3,969·19	3,107·57	4,243·62	4,672 25	2,732 08	4,067 63	2,590 08	2,803 52	3,854 19	3,139 99	3,064·01	3,799 30
Percentage yield taking B. S. 1 as control .	94·77	129·54	101 42	138 50	152 49	89 17	132 76	84 53	91 50	125 79	102 48	100 00	123 10

TABLE IV

Average yields of green fodder, grain and straw from Pusa oats 1936-37

(Plots 1/80th acre in size)

Yield of	Per	Mean yields in lbs.											
		A B. S. 1	B B. S. 2	C Hy. C	D Hy. VII-54	E Hy. VII-144	F Hy. VII-265	G Hy. G	H Hy. VII-578	I Iowa 103	J Hy. J	General Mean	Standard error of mean difference
Green fodder	Plot	154	132	161	132	138	136	148	153	155	155	146	10 3
	As a percentage of the general mean	105	90	110	90	95	93	101	105	106	106	100·0	7·1
Grain	Plot	23·38	20·24	16·70	15·06	12·94	16·06	17·08	18·36	19·52	23·31	18·27	1·11
	As a percentage of the general mean	128·0	110·8	91·4	82·4	70·8	87·9	93·5	100·5	106·8	127·8	100·0	6·1
Straw	Plot	33·44	40·16	41·30	34·74	38·68	35·54	36·14	40 04	50·28	41·66	39·20	2·42
	As a percentage of the general mean	85·3	102·4	105·4	88·6	98·7	90·7	92·2	102·1	128·3	106·3	100·0	6·17

A study of these figures shows that the yield of green fodder is much the same in all types, while in so far as grain yields are concerned those of B. S. 1, Hybrid J and B. S. 2 are statistically better than those of the rest which among themselves show considerable differences. The highest yield of straws was obtained by Iowa 103, the lowest from B. S. 1. This experiment, however, is not entirely conclusive, as the unusually long drought during the growth period of this crop, in the cold weather of 1936-37, appears to have been reflected in decreased crop yields, especially in the matter of the green fodder. It is proposed to repeat the experiment for further observations.

The number of strains of oats at Pusa, now on the distribution list or in the course of trial, is quite large. It is believed that enough material is thus available to meet the needs of the many different soil and climatic conditions under which the crop might be grown. It is therefore suggested that wider trials of Pusa oats might be with advantage undertaken by those interested in the improvement of Indian live-stock.

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THE VITAMIN A (CAROTENE) AND C CONTENT OF MANGOES*

BY

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MANGO is one of the most important fruits of India. However, it has not been given the scientific study it deserves. Lately, some attempts have been made to apply cold and gas storage to the fruit and explore the possibilities of an export trade. This has led to the estimation of the vitamin contents of a few selected samples. The number of varieties that are available in India is, however, very large and their food value and nutritive quality, the effect of grafting, pollination, climate, soil, manures and weather conditions (rainfall and humidity) on the quality of the fruit have to be carefully investigated. The quality of the fruit, as judged by the price, is not a true index of its nutritive value. The pulp in some cases is firm, while in others it is juicy. Some are rich in flavour, colour, or sweetness, while others are '*kutcha mitha*', *i.e.*, sweet even in the green unripe stage. There is, unfortunately, a tendency on the part of the growers to pluck the fruit as early as possible to avoid losses from storms, insects, birds, and other pests. Unless plucked at the full mature stage, even the best variety of fruit will suffer in quality. Determinations of the vitamin A and C content of the fruit offer us a clue to its food value and a method of studying the effect of environmental factors on the nutritive value of the fruit.

Vitamin A was estimated, as its precursor carotene, colorimetrically. After a few preliminary trials with well-known methods [Guilbert, 1934; Ferguson and Bishop, 1936; Pyke, 1936] of estimating carotene, a simpler method, better suited to the material, was evolved.

According to Ferguson and Bishop's method, the finely chopped material is digested under reflux with 20 per cent aqueous potash for two hours, cooled, and the fibrous portion is removed by filtration. The fibre is washed free from all soluble material with ether-saturated water and acetone. The combined filtrates are extracted with ethyl ether exhaustively and the ether extract is washed

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thoroughly with water. The solution is made up to volume and the colour compared with standard dichromate solution. The ether is evaporated off under reduced pressure and the residue is taken up in light petroleum. The carotene is partitioned off from xanthophyll with 90 per cent aqueous methyl alcohol. The colour comparison is made after suitable dilution and the carotene content determined with the help of the curves given by Ferguson [1935].

In the method adopted by us the mango pulp (5 to 10 grms.) is dehydrated by grinding with sufficient quantity of anhydrous magnesium sulphate in a glass mortar and pestle to a fine dry powder. This is extracted three or four times with petroleum ether and the carotene-xanthophyll partition made in the usual way. The methods of colour comparison and calculation are similar to those employed in Ferguson's method.

TABLE I

Comparison of Ferguson and Bishop's method and that adopted by the authors

Name	Ferguson and Bishop		Method adopted	
	Carotene mg. per kg.	Xanthophyll mg. per kg.	Carotene mg. per kg.	Xanthophyll mg. per kg.
Badami	134	40	140	10
Malgoba	6	4	12	Negligible

The latter method has advantages over Ferguson's method, in that the petroleum ether easily extracts the pigments in three or four extractions. Losses due to digestion at a high temperature and from the change of solvent—from ethyl to petroleum ether—are avoided. The possibility of interference due to saponifiable matter coming down in the petroleum ether extract was examined and found to be negligible. The quantity of xanthophyll in the extract was small.

Vitamin C was estimated by titration with Tillman's reagent and iodine solution. About fifty grammes of mango pulp were triturated in a glass mortar and pestle with enough of acetic acid to make up 5 per cent in the final volume. The pulp was put in a muslin cloth and exhausted with water. The extract was made up to volume and immediately titrated. The iodine solution and the Tillman's reagent were standardised against International Standard ascorbic acid. At no stage in the process was any metal allowed to come into contact with the pulp.

Four kinds of mangoes were available for the experiments. 1. Mangoes received from Vizagapatam representing Northern Circars and sent by rail. 2. Local varieties grown round about Bangalore. 3. Imported varieties grown in orchards in Bangalore. 4. Mangoes grown in the Cauvery valley near Seringapatam. All the samples could not be obtained in the best condition, especially those from distant places. The results given below are, however, of considerable use and interest to growers and consumers.

TABLE II

Carotene and vitamin C content of various species of mangoes

Source	Name	Carotene in mg. per kg.		Vitamin C in mg. per kg.		Remarks
		Dichromate colour comparison	Lovibond Tintometer	Iodine titration	Tillman's reagent	
From Vizagapatam	Banganapalli 1	5·6	6·4	0·097	0·015	Plucked too early
	Banganapalli 2	11·8	19·0	0·141	0·075	Fully ripe. Normal
	Peddarasam .	12·2	12·8	0·298	0·185	Did not develop full colour, flavour or sweetness
	Neelam . .	10·4	10·0	0·352	0·224	Ditto
	Himayudin Phasand . .	5·8	4·0	0·233	0·116	Ditto
	Suvarnarekha .	3·4	4·0	0·071	0·025	Ditto
	Nalla Andrews .	4·2	4·4	0·474	0·491	Ditto
	Jehangir . .	2·6	2·8	0·266	0·065	Ditto
Local	Badami . 1	140	..	0.740	0·456	Fully ripe. Normal.
	Badami . 2	80	108	..	..	Mature fruit. Ripened in the incubator at 37°C.
	Raspuri . 1	13·8	18·5	0·018	0·087	Fully ripe. Normal
	Raspuri . 2	15·2	22·0	0·139	0·112	Ditto
	Raspuri . 3	19·8	..	..	0·044	Ditto
	Malgova . .	12·0	..	0·191	0·157	Ditto
	Hamlet . .	5·4	4·8	0·559	0·515	Highly acid
	Sour Stone variety	11·4	13·5	0·760	0·830	Ditto

TABLE II—*contd.*

Source	Name	Carotene in mg. per kg. Dichromate colour comparison	Carotene in mg. per kg. Lovibond Tintometer	Vitamin C in mg. per kg. Iodine titration	Vitamin C in mg. per kg. Tillman's reagent	Remarks
Seringapatam	Badami . .	60	63	0·640	0·652	Better than the local variety in taste
	Amini . .	7·6	10·5	0·150	0·056	Very sweet
	Guava . .	6·0	8·0	0·567	0·593	Ditto. Good flavour
	Malagusunde amini	6·0	8·2	0·117	0·141	Ditto
	Velur Gola . .	50	..	0·191	0·145	Resembles Neelam
	Bather Gunde 1	11	14·5	0·125	0·093	Fibrous. Poor quality
	Bather Gunde 2	27·6	29·5	0·585	0·402	Rich yellow colour
	Raspuri seedling .	28	33	0·182	0·112	Fibrous. Poor quality
Imported varieties grown in Bangalore	Langra . .	30	33	0·158	0·112	Immature. Poor sample
	Bombay . 1	8·4	10	0·104	0·059	Ditto
	Bombay . 2	44·8	46	0·186	0·127	Ditto
	Gopal Bhog .	8·8	9·3	0·416	0·366	Poor sample
	Kutcha Mitha .	15	18·4	0·064	0·008	Ditto
	Krotahal chota .	23	28	0·105	0·035	Ditto
	Sabza Malda .	21·4	24	0·641	0·619	Ditto
	Alfonso . .	34	34·5	0·766	0·833	From a 2-year old graft. Poor sample
	Fazli Bhog .	14·8	15·3	0·159	0·152	Poor sample
	Palace Orchard .	18	20·8	0·186	0·132	Ditto

NOTE.—Iodine titration for vitamin C has generally given a higher value due possibly to other ingredients present in the juice that might have reacted with the iodine. While the same factor does not apply in the case of carotene determination by the Tintometer or dichromate solution, the chances of error due to the use of tinted glasses and other aspects of the technique followed in such determinations should not be under-estimated.

DISCUSSION

Vitamin A and C content increases during ripening after plucking. Any form of injury or damage that retards ripening decreases the vitamin value. The change

in colour of the pulp from pale yellow to rich reddish yellow is a fair indication of the increase in carotene content. The nature of the carotene, whether alpha, beta, or gamma, could not be determined for want of a suitable chromatographic technique. However, according to Yamamoto *et. al.* [1932], the carotene should consist mostly of alpha and beta varieties. The vitamin content depends on the variety and other factors. Crawford and Perry [1933] found the vitamin A content of 'Alfonso' to be approximately equal to that of good butter and that of 'Cowasji Patel' and 'Shendrya' to be about half. The vitamin C content of 'Alfonso' was about twice as high as that of lemon juice; the other two were less active. Guha and Chakravarty [1933] observed substantial variations in the vitamin content of the different varieties of the Indian mango. De [1937], using a spectrographic method, has determined the carotene content of about a dozen varieties of mango fruit.

The results of the present analysis (Table II) show that the vitamin content of mangoes varies very much from one variety to another. It should also be noticed that the time of plucking and stage of ripening influence the vitamin content to a very great extent and these factors, probably, are responsible for the very high variation in the values obtained for Badami 1, 2, and Badami from Seringapatam; Bombay 1 and 2; Bather Gunde 1 and 2. It is possible, however, that normal, fully-ripe fruit of each variety, grown in the same locality, can be characterised by a definite range within which the vitamin content may vary; and for this purpose, a thorough investigation of the influence of manuring, soil-fertility, and climatic conditions as also the time of plucking and stage of ripening on the vitamin content of the fruit is essential.

Fruits obtained from seeds (not grafted) are generally inferior and fibrous. They are not fit for table use, but are well suited for extraction of juice and drying in thin sheets artificially. The imported varieties appear to have suffered in quality generally. Banganapalli and Jehangir are the two most popular varieties of the Northern Circars and they are sold at a high price. They are very delicious and have a good flavour with firm pulp and are not fibrous. But they are very poor in vitamin content. Certain other varieties (*e.g.*, Nalla Andrews, Hamlet, Sour Stone), though poor in carotene content, are very rich in vitamin C; but on account of their high acidity, low sugar content, and fibrous pulp, they are not popular. However, they are eminently suited for pickle preparations. Their vitamin C content is very high—sometimes double that of lemons. Preserved in vinegar or lime juice, they should be ideal material for storing up vitamin C, and the industrial aspect of the preservation of such varieties is worth studying.

Among the local varieties, Badami is undoubtedly the best on account of its high carotene and ascorbic acid content. It is said to be the 'Alfonso' variety imported and grown in the Mysore State.

Summary

About thirty varieties of mangoes were analysed for their carotene and ascorbic acid content, using a simple technique for the estimation of carotene. There are very high variations in the vitamin content of the different species ; and even in the same variety they differ from one sample to another.

The influence of the time of plucking, stage of ripening, as also soil-fertility and climatic conditions on the vitamin content of the fruit is worth investigation.

Badami is the best among the varieties analysed.

Our best thanks are due to Dr. L. S. Doraiswamy of the Mysore Horticultural Department for kindly arranging to provide us with most of the samples used in this investigation.

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NOTE ON EFFECT OF STRIPPING OF DRY CANE LEAVES FOR PREVENTION OF DAMAGE BY PYRILLA ATTACK (UNITED PROVINCES—1935-36)

BY

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PRIOR to 1935 stripping of the dry leaves and removal to a distance from the field as a method of reduction of Pyrilla attack was conducted as opportunity arose on the Cawnpore Research Farm. The examination of this method was arranged for at Muzaffarnagar Research Station as a piece of the entomological investigations. The time available for this work at Muzaffarnagar was limited owing to the large amount of other routine observations for which the Assistant Research Entomologist was responsible. The experiment also could be conducted only on such areas as were not under cultural, manurial or irrigation experiments.

In the seasons 1935-36, 1936-37 Pyrilla attack was negligible. In 1937-38 Pyrilla infestation was very heavy. The limited area upon which stripping could be carried out involved the certainty of re-infection from the adjacent unstripped cane. Samples of cane were taken by a statistically valid method of randomisation, crushed and analysed for brix, sucrose per cent of juice and purity per cent on the dates shown in the appended table. Effects by way of increase or decrease percentage brix, sucrose and purity of the juice from stripped over unstripped samples are shown beneath each variety for each season from the Muzaffarnagar farm.

In September 1937 the sugarcane on the Bulandshahr Government farm was found to have developed a very heavy attack of Pyrilla and the dry leaves from the whole of the cane on the farm were stripped and heaped at a distance. One stripping only was given.

EXAMINATION OF THE RESULTS

Muzaffarnagar farm

1935-36.—Notwithstanding the fact that there was no serious Pyrilla attack on the Muzaffarnagar farm in this year, the figures for brix, sucrose and purity are appreciably higher in the stripped than the unstripped cane.

1936-37.—Brix was higher in the unstripped cane but sucrose and purity were higher on the stripped cane.

1937-38.—In all cases brix, sucrose and purity were appreciably higher in the stripped than in the unstripped samples. In the case of Co. 508 samples from

unstripped fields of the farm in which no reduction of the pest could have taken place from the stripping experiment, the effect in favour of stripping was much more marked than in the case of the samples from stripped and unstripped portions of the same field where the disturbance caused by stripping is likely to have resulted in redistribution of the Pyrilla population between the stripped and unstripped portions thus masking the beneficial effect.

Bulandshahr farm

The whole of the cane on the Bulandshahr farm was stripped. No valid comparison is possible with cultivator's cane in the neighbourhood. Here it was not found necessary on this occasion to strip more than once as after the first stripping the Pyrilla attack became negligible. The results must be judged by the average standard of cane of the area in a normal year. The figures for November, January and February indicate that in brix, sucrose and purity the resultant crop was up to normal standard.

The data presented is incomplete. All available information will be included in the next progress report of the United Provinces Sugarcane Research Scheme. Earlier and later strippings have been made with equally good results. It would appear that even in the absence of severe Pyrilla attack stripping of cane during the later part of the monsoon results in a sufficient increase in sucrose content to render the practice economic.

Preliminary figures showing the Brix, sucrose per cent juice and purity from cane subjected to stripping of dry leaves on August or September on Muzaffarnagar and Bulandshahr Government farms

Year and place	Variety	Treatment	Juice analysis			Juice analysis			Juice analysis			Remarks
			Per cent Brix	Per cent Sucrose	Per cent Purity	Per cent Brix	Per cent Sucrose	Per cent Purity	Per cent Brix	Per cent Sucrose	Per cent Purity	
				6-12-1935			*24-2-1936*					
1935-36	Co 370	(a) Stripped September.	15·82	12·44	78·45	18·39	15·89	86·40				Pyrilla attack not serious this year.
Muzaffarnagar	Co 370	(b) Unstripped .	14·87	11·28	75·67	18·12	15·58	85·90				
		Increase (a) over (b)	0·95	1·16	2·78	0·27	0·31	0·50				
	Co 313	(a) Stripped September				19·89	17·81	89·55				
	Co 313	(b) Unstripped .				19·59	17·30	88·35				
		Increase (a) over (b)				0 30	0·51	1·20				
							27-2-1937			*18-3-1937*		
1936-37 .	Co 312	(a) Stripped September				19·52	17·42	89·25	20·19	18·14	89·75	Pyrilla attack not serious again this year.
Muzaffarnagar	Co 312	(b) Unstripped .				19·72	16·69	84·55	20·49	18·02	87·80	
		Increase (a) over (b)				−0·20	0·73	4·70	−0·30	0·16	1·95	
				21-12-1937			*26-2-1938*					
1937-38 .	Co. 312	(a) Stripped September.	15·08	11·44	75·80	17·09	14·19	83·05				
Muzaffarnagar	Co 312	(b) Unstripped .	14·08	10·40	73·80	15·69	12·35	78·75				Pyrilla attack severe.
		Increase (a) over (b)	1·00	1·04	2·00	1·40	1·64	4·30				
	Co 508	(a) Stripped September	17·39	14·65	84·25	18·63	15·36	82·50				Same field.
	Co 508	(b) Unstripped .	15·33	11·58	75·65	17·67	14·21	80·35				
	Co 508	(c) Unstripped .				16·23	12·52	76·76				Average of unstripped fields of farm.
		Increase (a) over (b)	2·06	3·07	8·60	0·96	1·15	2·15				
		Increase (a) over (c)				2·40	2·84	5·74				
	Co 560	(a) Stripped September	16·29	12·57	77·25	18·40	15·59	84·75				
	Co 560	(b) Unstripped .	13·59	9·24	68·00	16·00	12·10	75·65				
		Increase (a) over (b)	2·70	3·33	9·25	2·40	3·49	9·10				
				24-11-1937			*8-1-1938*			*5-3-1938*		
1937-38 Bulandshahr .	Co S 19	Stripped September	15·52	11·96	77·05	17·96	14·23	84·20	19·33	16·06	83·15	The whole area under sugarcane at Government Bulandshahr farm was stripped from 7th to 11th, September as it was very badly infested with Pyrilla. The pest attack became negligible after one stripping.
	Co S 60	,, .	16·02	12·54	78·30	18·24	14·74	80·30	20·83	17·94	86·20	
	Co 300	,, .	16·62	13·79	83·00	18·24	15·05	82·25	20·96	18·75	89·35	
	Co 312	,, .	13·22	9·74	73·75	17·66	14·38	81·40	18·96	15·82	83·40	
	Co 313	,, .	16·22	12·98	80·10	18·14	14·88	82·02	21·26	18·32	86·20	
	Co 331	,, .	15·64	11·61	74·20	17·64	14·26	80·78	20·86	18·27	87·70	
	Co 370	,, .	15·22	10·88	71·50	18·06	14·67	81·20	19·56	17·54	89·65	
	Co 385	,, .	16·05	12·56	78·30	18·66	15·77	84·50	21·29	19·09	89·70	
	Co 508	,, .	16·58	12·93	77·95	19·96	16·99	85·12	19·79	16·08	81·30	

STUDIES ON THE LOSS OF FAT DURING BUTTER-MAKING AND PREVENTION OF THIS LOSS

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THE profits in the manufacture of butter on a commercial scale depend to a large measure upon the maximum recovery of butterfat from the cream during the process of churning. Some fat is always carried away in the buttermilk and the amount thus lost largely depends on the conditions of working. The present investigation was therefore undertaken with a view to so modifying the process as to reduce the fat losses in buttermilk to a minimum and thus making the manufacture of butter more economical. In the course of the experiment, therefore, citric acid and sodium citrate were added to cream, and their effect on the flavour, aroma, grain structure and the keeping quality of the resulting butter was studied. Some of the previous workers have employed citric acid and sodium citrate without reaching any definite conclusions as to their usefulness. Thus, Hunziker [1927] states that the addition of citric acid in cream-ripening may be of some value in the production of flavour and aroma in butterfat, but that our present knowledge is too limited to justify its recommendation for general practice. Templeton and Sommers [1935] used citric acid and sodium citrate in buttermaking and noticed that citric acid tended to lower the fat losses in the buttermilk. Greenbank and Holm [1934] and Lea [1936] have recommended sodium citrate and citric acid as powerful anti-oxidants. This observation has, however, been contradicted by Olcott [1934].

In the present work a critical study is therefore made of the various effects, such as on aroma production, prevention of fat losses in buttermilk, etc., which citric acid and sodium citrate are supposed to exercise.

I. EXPERIMENTAL

(i) *Preparation of cream*

The cream was taken fresh from the separator and standardised to the desired fat percentage. Flash pasteurised at 160°-165°F. (71·11° to 73·88°C.) and then cooled rapidly to 70°F. (21·1°C.). After pasteurisation starter was added to the cream at the rate of 3 lbs. of starter for every 100 lbs. of cream. Before mixing with the cream the starter was strained through a fine muslin. The acidity of the starter was between 0·7 and 0·8 per cent (lactic acid). The cream was then divided into three lots of equal weight. Two of these samples were treated with

100 c. c. of 0·2 per cent of well-boiled and filtered sodium citrate and citric acid solutions respectively and the samples thoroughly stirred. The third sample served as control. In order to control the acidity in the three samples, *viz.*, untreated cream, sodium citrate treated and citric acid treated, it was necessary to keep them for ten hours, first two at about 72°F. and the third at 68°F., for the development of the required acidity, *viz.*, 0·25-0·30 per cent lactic acid.

(*ii*) *Temperature of ripening*

After the pasteurisation of the cream as explained above, the cream was aged for fourteen hours at 48° to 50°F. Observations were made with a view to study the influence of holding cream at high temperatures ranging from 48° to 64°F. on the loss of fat in buttermilk. The concentration of fat in cream was thirty per cent and it was churned at 54°F. The results are illustrated in Figs. 1 and 2. According to Toens and Hammer [1925] lower temperatures (68° to 72°F.) provide satisfactory conditions for starters. This range of temperature has the added advantage of being unfavourable to the growth of organisms which resist pasteurisation. At higher temperatures the acid development increases and this generally occurs at the cost of the desired flavour and aroma. The high acid content of cream precipitates the casein which locks up fat in the curd and some of it passes in the buttermilk.

(*iii*) *Effect of citric acid and sodium citrate on the flavour and aroma of butter*

The butter samples treated with citric acid and sodium citrate had always a superior aroma than the control (untreated samples). Table I below shows scores on butter flavour and aroma.

TABLE I

Average score of thirty samples of butter made with the addition of citric acid and sodium citrate

	Initial	10 days	20 days	30 days	60 days
Control . . .	+++	+++	+	+	--
Citric acid . . .	+++	+++	++	+	-
Sodium citrate . .	+++	+++	+++	++	+

Further, samples treated with citric acid produced better aroma than those treated with sodium citrate. This shows that citric acid and sodium citrate favour the development of good flavour and aroma. According to Hunziker [1927] these substances are utilized by the flavour producing organisms during cream ripening, for the purpose of developing volatile acids upon the presence of which depends the flavour and aroma characteristic of good butter. Hence if sufficient amount is not present it interferes with the development of good odour.

(iv) *Manufacture of butter*

Butter was made in hand churns, and as far as possible, under identical conditions. Three churnings were prepared daily, one treated with sodium citrate the other with citric acid and the third was control. Butterfat determinations were made by Gerber's method both on the cream and buttermilk. The following optimum conditions o manufacture were observed.

(a) *Temperature.*—For each churning ten lbs. of cream was used varying in fat percentage from twenty to fifty. The atmospheric temperatures during the experimental period varied from 72° to 74°F. The cream was churned between 54° to 56°F., this being the optimum temperature for churning under the experimental conditions. With a higher temperature there was a rapid aggregation of fat globules and with a very high temperature there was a further division of large globules, which resulted in a greater loss of fat in the buttermilk. On the other hand when too low a temperature was used in churning the period of agitation was considerably prolonged as under this condition the fat globules got hard and did not cohere. The low temperature also affected the shape of the fat globules. The effect of low temperature was noticeable to a more marked degree on cream of low fat per cent *i.e.* below thirty per cent than on cream of high fat per cent.

(b) *Richness and consistency of cream.*—When cream with a high (35-50 per cent) or too low (below 30 per cent) a fat per cent was churned, greater loss of fat occurred in the buttermilk as shown in Fig. 2.

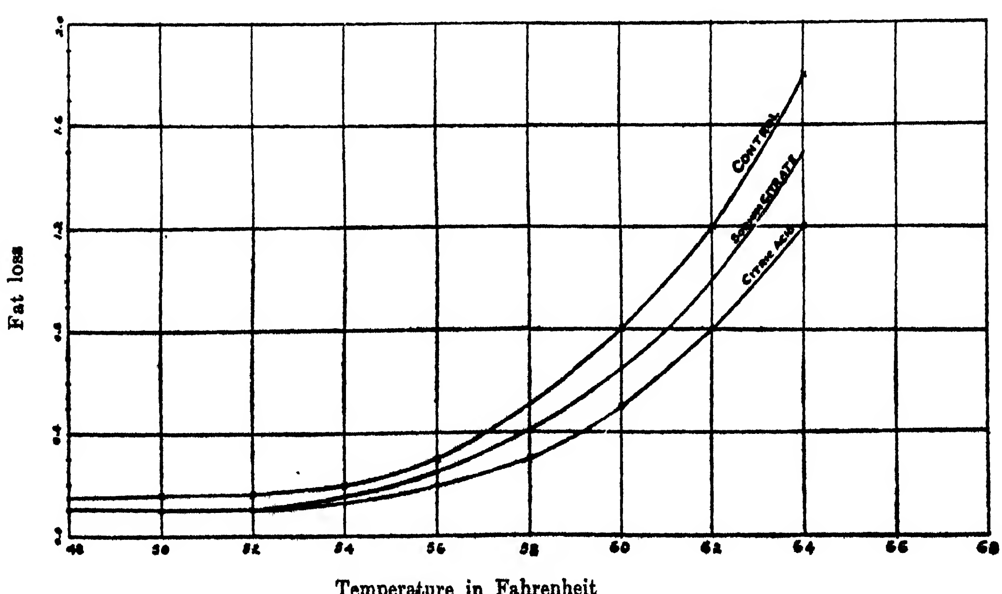
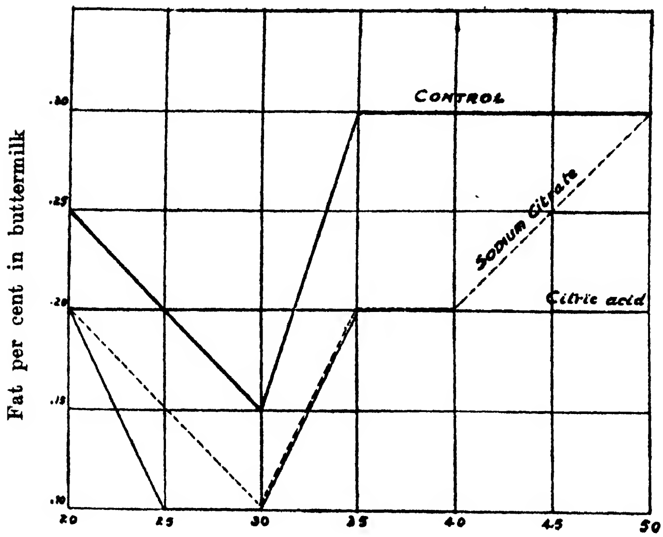


Fig. 1



Fat per cent in cream

FIG. 2

The best results were obtained when cream with 30 per cent fat was churned. From the economic stand point it is not advisable therefore to churn too thin or too thick a cream. In the former case there was less agitation of cream due to a large portion of milk serum being present which acted as a buffer, and prolonged the churning period. Rich cream generally churns easily when agitated, but too often the cream gathers in the form of thick plastic mass and becomes viscous. This viscous cream adheres to the walls of the churn which makes it difficult to agitate, thereby prolonging the churning period. When the cream churns with difficulty butter granules are exceedingly slow in gathering and this results in a greater loss of fat in the buttermilk (Fig. 2). This loss of fat is further increased by certain amount of unchurned cream adhering to the walls of the churn. When however cream with fat content of thirty to thirty-five per cent is churned there is a maximum recoverability of butterfat from the buttermilk and the churning process is completed in a comparatively short period.

(c) *Speed of churning.*—To effect maximum agitation of cream it is important to maintain a uniform speed of the churn. This also results in uniform sized grains. As soon as the 'breaking' stage is reached

the agitation should be carried out with great care till the grains attain a fair size. The 'breaking water' should be added in two stages. Half the quantity should be added first and the agitation continued till the grains attain the size of pin heads and then the remaining quantity of 'breaking water' added and churned till the desired size of grain is obtained. This method of adding 'breaking water' allows sufficient time for the grains to attain their maximum size. If the butter granules are very small, due to under-churning, an excessive loss of fat in buttermilk occurs. However, complete agitation of the cream is not possible since some of the fat is in such a stable emulsion that it escapes unbroken during churning.

Other things being equal, the samples treated with citric acid and sodium citrate showed better separation of fat from the cream than the control samples (Figs. 1 and 2). Citric acid was superior to sodium citrate in this respect. The loss of fat in the buttermilk was reduced to a minimum when the fat content of the cream was maintained at 30 per cent. At this concentration, sodium citrate compared very favourably with citric acid which registered the lowest fat loss in the buttermilk. The cream treated with citric acid took slightly less time to break than the other two samples, acidity and other conditions remaining the same. After drawing the buttermilk, a sufficient number of washings was given to the butters treated differently to effect the removal of buttermilk. Then the butter was removed on the butter worker and worked once; three per cent salt was sprinkled over the butter which was then worked three times. The moisture content of this butter varied from 13·5 to 14 per cent. The butter was wrapped up in double butter paper. Each butter sample was divided into three parts of half pound each and immediately transferred to the cold store maintained at 50°F. Each of the samples was examined after definite intervals for flavour, aroma, and keeping quality. The resulting butter from the cream treated with citric acid and sodium citrate had an agreeable flavour and aroma. Though the treated cream had a pronounced aroma in the case of citric acid samples as compared to sodium citrate samples, there was very little difference in the resulting butter.

(v) *Keeping quality of the butter*

Experiments on the keeping quality of the butter samples prepared by the above method showed that the butter from cream samples treated with sodium citrate had a longer induction period than those treated with citric acid or the controls. The results are given in Table II.

TABLE II

*Peroxide test on the butter samples stored at 50°F. after various treatments**

Name of the sample	No. of samples tested	No. of days old	$N/100$ sodium thiosulphate required for 100 g. of samples
Control	30	20	2·03
Citric acid treated	30	20	nil
Sodium citrate treated	30	20	nil
Control	30	30	9·9
Citric acid treated	30	30	7·0
Sodium citrate treated	30	30	6·28
Control	30	40	12·5
Citric acid treated	30	40	8·7
Sodium citrate treated	30	40	6·9
Control	30	60	16·2
Citric acid treated	30	60	13·1
Sodium citrate treated	30	60	9·1

*Peroxide was estimated by the method described by Wheeler [1932].

The results show that with sodium citrate the induction period after sixty days is almost doubled.

II. DISCUSSION

Addition of citric acid and sodium citrate to the cream improves the aroma, flavour, and keeping quality of the resulting butter. The loss of fat in the buttermilk can be reduced to a considerable degree by the addition of one of these compounds to the cream. This may be due to the promotion of clumping of fat globules. Van Dam and Sirks [1932] and Palmer and Anderson [1926] studied the factors influencing creaming and concluded that milk plasma primarily influences creaming. Rahn [1921] has drawn similar conclusions. It is probable that citric acid brings about the coagulation of casein contained in the cream, thus setting free the absorbed butterfat held in mechanical combination with casein, with the result that the loss of fat in buttermilk is reduced. It is found that in order to obtain the minimum loss of fat in the buttermilk the fat percentage of cream should be maintained at thirty. This also produces grains of ideal size. Another important factor which determines the loss of fat in the buttermilk is the ageing and churning temperature. The rate at which aggregation of fat occurs is primarily dependent upon the temperature. If the temperature is very low the globules do not adhere to one another and therefore churning of cream merely distorts the shape of the globules and causes no aggregation. Again if the temperature is very

high the number of larger globules produced is relatively very small and even sub-division of the glolules occurs. The optimum temperature under the experimental conditions was found to be 54°—56°F. Butter made from cream treated with sodium citrate keeps better than that made from cream containing citric acid ; the control samples being comparatively very poor in this respect.

III. Summary

(1) When the concentration of fat in the cream is maintained at thirty per cent a minimum amount of fat is lost in the buttermilk.

(2) The optimum temperature of ageing is 48°—52°F. and that of churning the cream 54°—56°F.

(3) Citric acid and sodium citrate reduce the loss of fat in the buttermilk to a minimum, registering in both cases 0·1 per cent loss when cream with thirty per cent fat is churned. Control samples showed a loss of 0·15 per cent fat.

(4) Addition of citric acid or sodium citrate to the cream improves the flavour, aroma, and keeping quality of the resulting butter.

Acknowledgments

I am greatly indebted to Mr. Zal R. Kothavalla, Imperial Dairy Expert, for providing me the necessary guidance and helping me in judging the butter samples, to Mr. S. Cox and Mr. H. C. Verma for grading the samples of butter.

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SELECTED ARTICLE

THE "HAY-BOX" METHOD OF HEATING MILK, FOR INDIGENOUS GHI-MAKING

BY

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(*Punjab Veterinary Service*)

(Reprinted from the Veterinary Bulletin No. 8 of the Civil Veterinary Department, Punjab, 1936)

THE " hay-box " is a means of storing heat, and is used for cooking or keeping food hot for long periods, when fuel is scarce. It is a very ancient practice, and is used with great success by armies in the field.

Recently, experiments have been carried out in the Punjab, to ascertain whether this practice can be applied for heating milk in Indian households, to save fuel. The bulk of fuel used for heating milk at present is made from cowdung, which would have a much greater economic value if put back into the land to fertilise crops.

The series of experiments carried out at the Government Cattle Farm, Hissar, indicate that milk heating by the hay-box method not only saves fuel, but produces a large amount of *ghi* from a given quantity of milk.

There are various methods of preparing milk for *ghi* in the villages, the more common of which are as follows :—

1. The morning milk is brought to the boil and then stands all day cooling off until the unboiled evening milk is added.

2. The morning milk is simmered all day, and the evening milk is boiled and added to it.

3. The morning milk is simmered all day, and the evening milk is added to it, unboiled.

By all three methods the subsequent operations are the same, *viz.*, the " starter " (usually a piece of curd or *lassi*) is added to the milk at night, which becomes ready for churning in the morning.

The tabulated statement at the end of this article shows a comparative result of these three methods. It also clearly shews the benefits of introducing the hay-box into methods 2 and 3. It will be observed that method 3-A gave the best results, and that this is a combination of indigenous method 3 and the hay-box. Moreover, it will be noticed that in each case the hay-box is superior to the indigenous methods, inasmuch as it saves fuel, produces more *ghi* per pound of milk used, and makes very palatable *lassi*.

It should be mentioned that the work in connection with these trials, was carried out by an Indian lady using the ordinary indigenous vessels and utensils in common use. An official of the farm simply did the weighing and measuring of the materials used, and explained the use of the hay-box to her. It is, therefore, quite obvious that this method of milk-heating can easily be done in any Indian household.

Each trial was repeated several times, to avoid any possibility of error, before the final results were tabulated.

How to use the "Hay-Box"

(*i*) As it is necessary that the morning milk should almost fill the vessel (*kaharni*) in which it is to be heated, a *kaharni* of the correct size should be obtained.

(*ii*) Procure a wooden box, the length and breadth of which should be about twice the greatest diameter of the *kaharni*, and about ten inches more than its height. If the planks of the box are not a good fit, a carpenter should take it to pieces and rebuild it so that air cannot easily pass between the planks. The lid should have some small strips of wood fitted on the inside, so that it fits tightly into the top of the box.

(*iii*) Place dry hay or *bhusa* in the bottom of the box, and press it down firmly —but not too tightly—to a depth of about six inches.

(*iv*) Bring the milk in the *kaharni* to the boil and when quite certain that it is boiling, place the *kaharni* in the centre of the box on the bed of hay or *bhusa*. More dry hay or *bhusa* should then be packed into the box all round the *kaharni* up to a level with the top. If desired, a metal or wooden cap may be placed over the top of the *kaharni*, so that it can be completely covered with the hay. The box should then be put out of the way until the evening.

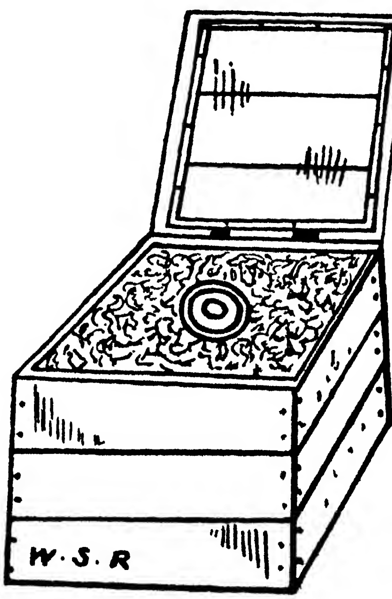
(*v*) Pour the evening milk, unboiled, into the *chati*. Open the hay-box, remove the *kaharni*, and pour the milk into the evening milk already in the *chati*. Add the "starter" and do the churning next morning in the usual manner.

The above is an extremely simple process, and provided that sufficient care is taken to keep the hay or *bhusa* used, perfectly dry, it can be carried out by anyone with immediate success.

Hay-boxes may also be made of metal, or may be built of *kacha* or *pucca* brick adjacent to the cooking place, but they must be provided with well fitting lids.

If the hay-box is adopted as the general method of heating milk, the provision of special fire-places, or *haras*, or *dudarnas* for heating milk, will become quite unnecessary. In most families, a meal is cooked early in the mornings, and the fire used for this can afterwards be utilised for bringing the milk in the *kaharni* to the boil, by the expenditure of only a very little more fuel. The wasteful habit of simmering milk for long periods on a separate fire can be totally discontinued where the hay-box is brought into daily use.

The sketch given below depicts a hay-box made from a packing case, with the *kaharni* of hot milk inside.



HAY-BOX

GOVERNMENT CATTLE FARM, HISSAR

Results of comparative trials of milk-heating "Hay-box" v "Indigenous" methods

Detail	Unit	1	2	2-A	3	3-A	Remarks
		Morning milk brought to boil, allowed to go cold; evening milk added unboiled	Morning milk simmered all day and evening milk boiled and added	Morning milk brought to boil and placed in Hay-box; evening milk boiled and added	Morning milk simmered all day and evening milk added unboiled	Morning milk brought to boil and placed in Hay-box; evening milk added unboiled	
1. Total morning and evening milk used.	lb.	60	60	60	60	60	The fat percentage of the milk was the same in all cases.
2. Amount of water added	lb.	..	6	..	6	..	
3. Total fuel for heating milk	lb.	8	14·5	7·5	15	7·5	
4. Total butter produced	lb.	3·159	3·009	3·495	3·063	3·404	The fuel used for making the *ghi* is not included.
5. Amount of water added for churning.	lb.	18	15	18	12	18	
6. Amount of *ghi* produced	lb.	2·383	2·317	2·478	2·417	2·537	
7. Amount of *lassi* produced	lb.	75·0	71·5	74·3	69·0	75·0	The fuel used in all cases was cowdung cake (*upla*).
8. Milk to make 1 lb. *ghi*	lb.	25·178	25·564	24·213	24·824	23·650	
9. Taste of butter and *ghi*	lb.	Good	Good	Good	Good	Good	
10. Taste of *lassi*	lb.	Good	Good	Very good	Good	Very good	

SUMMARY OF RESULTS

Method No. 3-A first place.
,, ,, 2-A second place.
,, ,, 3 third place.
,, ,, 1 fourth place.
,, ,, 2 fifth place.

NOTES

BULLETINS ON SEED PRODUCTION OF HERBAGE AND FORAGE PLANTS

A SERIES of six Bulletins has been published by the Imperial Bureau of Herbage Plants, Aberystwyth, on questions relating to the production of seed of herbage and forage plants. In view of the number of bred and selected strains now being reproduced for seed in different parts of the world, the agronomical technique to be used in the production of seed is an important question at the present time. The Bulletins are intended for the use of agricultural research workers, advisers, seed producers and seedsmen, and will also be of value to practical farmers, who will find information on many points which are important in the production of good crops of clean seed of grasses, clovers and other forage plants under a wide range of climatic and other conditions.

The chief Bulletins in the group are Nos. 19 (5/-), 22(5/-), and 23 (5/-). Bulletin 19 describes the technique used in producing seed of a number of grasses in all parts of the world, while Bulletin 23 is a companion issue dealing with legume (clovers, lucerne, etc.,) seed production. Bulletin 22, by Gwilym Evans, Officer-in-charge of Seed Production on the Welsh Plant Breeding Station, contains a description of the technique which has been evolved for producing seed of the various hay and pasture strains bred at the Station. Special consideration is given to the dates and rates of sowing, isolation, manures and fertilizers, harvesting, seed conditioning and storing. The Bulletin contains a brief statement of the new scheme for marketing seed of these bred strains, in which collaboration will be assured between the Station on the one hand and the Seed Trade and the Growers' Association on the other ; a complete scheme of inspection and certification will be incorporated. The final section of Bulletin 22 is a list of the bred strains released by the Welsh Plant Breeding Station, with a brief statement of the characteristics of each.

The other Bulletins on the subject of seed production are No. 20(2/6) on insects and other pests injurious to the production of seed in herbage and forage crops, by H. F. Barnes of the Entomology Department, Rothamsted Experimental Station, Bulletin 21(1/-), on the influence of climatic conditions on type composition, by N. Sylvén of the Plant Breeding Station, Svalöf, Sweden, and No. 24(2/-) on the collection of native grass seed in the Great Plains, U. S. A., by F. J. Crider and M. M. Hoover. This last publication will be of particular interest to persons in the more arid grassland countries, where erosion is a problem, as

it contains illustrations of the typical grasses of the Great Plains, which are being reproduced in connection with the soil conservation programme.

Copies of these Bulletins are obtainable from the Chief Officer, Imperial Bureau for Herbage Plants, Aberystwyth.

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THE INTERNATIONAL INSTITUTE OF AGRICULTURE

The following "Notes on the International Institute of Agriculture" are reprinted from the supplement pages of the "International Bulletin of Plant Protection", January, 1938, issued by that Institute.

General Assembly (May 1938).—The XIVth General Assembly of the International Institute of Agriculture will commence on Monday, 23 May 1938, at 10 A.M. at the Institute, with the agenda established by the Permanent Committee and approved by the adhering Governments.

Permanent Committee (Meeting of December 1937).—The Permanent Committee of the International Institute of Agriculture held the last meeting of the year on 13, 14 and 15 December.

The Permanent Committee in addition to the usual questions: the Secretary General's Report on the Services and Administration, Financial and staff questions—examined the programme of the next General Assembly (May 1938), the results of the Conference of Agricultural Statisticians for the World Agricultural Census of 1940, the participation of the representatives of the Institute in the next meeting of the Permanent Agricultural Commission of the International Labour Office (Geneva, February 1938), etc.

Publications of the Institute.—During the past three years readers of "Government Measures Affecting Agricultural Prices" have been kept informed of governmental legislation and activity regarding the production of, and trade in, agricultural products. A quarterly publication such as this, however, does not enable a sufficient quantity of material to be published, nor does it permit rapid notification of official modifications which are being made so frequently. The International Institute of Agriculture has, therefore, decided to continue publication of decisions which might affect agricultural prices in the form of a monthly "International Chronicle of Agriculture", which as from January 1938, will be incorporated in the "Monthly Bulletin of Agricultural Economics and Sociology".

The list of books presented to the Library will appear as from January 1938, on these coloured sheets. Consequently instead of the book list, up to the present published separately in the two Bulletins (Economic and Technical), there will now be one list, in which the books will be classified under authors' names and in alphabetical order.

For the future, the prices indicated on the Institute's publications will be *net prices* (post free).

The International Conference of Agricultural Statisticians for the World Agricultural Census of 1940.—The International Conference of Agricultural Statisticians for the Second World Agricultural Census was held in December at the International Institute of Agriculture.

The Conference held nine meetings from 13th December during which it discussed suggestions put forward by the various Governments and by the statisticians present for the revision of the draft Standard Form for the World Agricultural Census of 1940 which had been prepared by the International Institute of Agriculture after the first Conference held in October 1936. The execution of the census and the presentation of its results were also under discussion.

After a thorough examination and exchange of views the Conference made a number of recommendations of a technical or general nature which the International Institute of Agriculture will put in a concrete form. The programme for the World Agricultural Census of 1940 will be prepared in its final form on the lines of these decisions and will then be recommended to the various Governments.

Meetings of Commissions of Experts.—During the month of December, there took place at the International Institute of Agriculture several meetings of experts, called together for the study of the technical aspects of certain problems.

A *Small Commission of experts in Cereal Chemistry* was convened by the Institute and met on 6 and 7 December, to study the technical aspects of the action to be taken as the result of a Resolution passed by the International Congress of Agriculture of Budapest (1934) with a view to the study of the best means for bringing about an international understanding with regard to the question of the standardization of the methods of analysis of wheats.

This Commission, whose work was of a quite preliminary character, presented a Report which is submitted to all the Governments of the Member States.

The Governments have been requested to let the Institute know their views on the different questions mentioned in this report.

After ascertaining the views expressed by the Governments, the Permanent Committee of the Institute will decide on the action to be taken.

Wishing to improve the work of the Institute in the field of *Tropical and Sub-Tropical Agriculture* and in *Horticulture*, the Permanent Committee convened two Commissions of experts, for the purpose of indicating those points comprised in these sectors on which it would be advisable for the work of the Institute to be intensified. These two Commissions which met in December 1937, have presented two interesting advisory reports, which will come up for consideration by the Permanent Committee at its March meeting.

The Institute also announces the publication of the following books :—

1. La Legislation du Commerce des Plantes (published in French only). (In the press).

This monograph will appear during the first quarter of 1938 and this new edition (second) is considerably more complete than the preceding one. In fact the volume in preparation includes sixty countries instead of thirty-seven and it may be said that it is truly universal.

2. Recueil de Coefficients et Dequivalences (published in French only), Rome, 1937, 296 pp. Price 15 Lire.

This new edition (fifth) comprises far more detailed information than was published in 1922. It gives an account of the system of weights and measures in use in various countries and contains a brief summary of the numerous changes in the value of different currencies since the pre-war period up to the present day.

3. International Year-book of Agricultural Statistics, 1937-38, Volume XXI, about 1000 pp. Price 100 Lire, cloth bound 105 Lire (post free).

This book now in its 20th Volume (the first volume was published in 1912) is an indispensable work for all who undertake studies having any connection with production, trade, or prices of agricultural products. It is hoped to publish this edition for 1937-38 during the month of May next.

4. Annuaire International de Legislation Agricole, 1937. Volume XXVII, about 1000 pp. (In French only). Price 85 Lire, cloth bound 90 Lire (post free).

This book represents an account of the complete collection of laws classified systematically in the different volumes from 1911 up to the present time, a reference book which Governments and those interested in the study of agricultural questions considered indispensable for the compilation of new draft laws, and for the completion of any study which involves a knowledge of agricultural legislation of the different nations.

In addition, a few books of a new series of world production and trade in agricultural products are published. These represent the result of a new plan of work by the Institute inaugurated in 1934 to show the position of agriculture in relation to the International trade. They are designed to provide a document to show changes and effects of various economic policies and their influence upon the welfare of the agricultural industry.

Already issued—

1. World Cotton Production and Trade (Rome, 1936, xii + 464 pp. 8vo., with maps and diagrams). Price 30 Lire.
2.—International Trade in Meat (Rome, 1936, xii+424 pp. 8vo., with diagrams. Price 25 Lire.

In preparation :

3. World Production of Meat.
4. Fats and Oils : World Production and Trade.

The various publications of the Institute may be obtained in London from Messrs. P. S. King and Son, Westminster, or may be ordered direct from the Institute or through any bookseller.

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CHANGES IN TITLES OF SOME OF THE IMPERIAL AGRICULTURAL BUREAUX

In pursuance of the recommendations of the British Commonwealth Scientific Conference, 1936, the Executive Council of the Imperial Agricultural Bureaux have decided to adopt the following revised titles for certain bureaux with effect from the first January 1938 :—

(*a*) The Imperial Bureau of Plant Breeding and Genetics (at Cambridge).
(*b*) The Imperial Bureau of Pastures and Forage Crops (at Aberystwyth).
(*c*) The Imperial Bureau of Horticulture and Plantation Crops (at East Malling).
(*d*) The Imperial Bureau of Animal Breeding and Genetics (at Edinburgh).
(*e*) The Imperial Bureau of Agricultural Parasitology (Helminthology (at St. Albans).

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THE THIRD INTERNATIONAL CONGRESS FOR MICROBIOLOGY

The Third International Congress for Microbiology will be held at the Waldorf-Astoria Hotel, New York City, September 2-9, 1939, under the auspices of the International Association of Microbiologists.

T. M. Rivers, M.D., President, Rockefeller Institute for Medical Research York Avenue and 66th Street, New York City.

M. H. Dawson, M.D., General Secretary, College of Physicians and Surgeons, 620 West 168th Street, New York City.

Kenneth Goodner, Ph.D., General Treasurer, Rockefeller Institute for Medical Research, York Avenue and 66th Street, New York City.

The Congress will be composed of the following nine sections :—

1. General Biology : Variation and Taxonomy. Convener : C. E. A. Winslow.
2. General Biology : Microbiological Chemistry and Physiology. Convener : Stuart Mudd.

3. Viruses and Viral Diseases. Convener: W. A. Sawyer.
4. Rickettsiae and Rickettsial Diseases. Convener: Hans Zinsser.
5. Protozoology and Parasitology. Convener: H. W. Stunkard.
6. Fungi and Fungous Diseases. Convener: B. O. Dodge.
7. Medical and Veterinary Bacteriology. Convener: F. P. Gay.
8. Agricultural and Industrial Microbiology. Convener: S. A. Waksman.
9. Immunology. Convener: M. Heidelberger.

Registration fee will be $5.00 which will not include the cost of a banquet ticket or a copy of the Proceedings of the Congress.

A World's Fair will be held in New York City during the summer of 1939. Consequently, those who wish to attend the Congress for Microbiology should make plans promptly. The American Express Co., the official travel agency for the Congress, will be glad to assist in such plans.

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THE MARGIN BETWEEN PRODUCERS' AND CONSUMERS' PRICES OF CERTAIN FOODSTUFFS

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

This report, undertaken in connection with the International Institute of Agriculture's work for the League of Nations Nutrition Commission, is designed to collect, summarize and interpret data relating to the costs of distribution of foodstuffs. It contains information relating to twelve countries, some of which is original and the remainder only being available in scattered and not easily accessible documents.

The main problems which the report discusses are the size, composition and movement of the distributive margin, the degree to which, and the reasons wherefor, the margin may be excessive, and the possibility and methods for reducing them, and thereby the cost of foodstuffs to the consumer. It will thus be of interest not only to producers and distributors but also to consumers and their organisations whose interest in the reduction of the prices of foodstuffs is becoming increasingly marked in view of the rising tendency of the cost of living in most countries of the world. The importance of the questions is shown by the statistics, amply provided in the report, which show that in some countries the cost of distribution in all the processes involved in the passage of a given commodity from farmer to consumer, averages from forty to sixty per cent of the consumer's price. Further the report shows that for a whole series of seasons, the long term trend is towards a continual increase in the size of the margin.

The division of the work into two parts, one containing separately the information relating to each country and the other presenting the conclusions which a collective study of such information reveals, makes possible the separation of problems of a general interest from those of the more limited national character and will facilitate its use for reference purposes.

The report concludes that, there are sufficient possibilities of reduction of distributive costs to justify the belief which underlay the proposal of the League Committee on Nutrition to the Institute to collect material on the distributive margin—the belief, namely, that research in this field, continued with appropriate action, could contribute to lowering prices of necessary goods to the consumer, and to the improvement of nutrition standards.

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FARM ACCOUNTANCY STATISTICS FOR 1932-33 AND 1933-34

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

The International Institute of Agriculture at Rome is about to publish the sixth volume of the "Farm Accountancy Statistics". This publication contains tables bringing together the chief agricultural statistics for about twenty European countries and for the United States of America. It makes available in a form which facilitates comparisons as much as possible a series of international statistics. This publication is all the more important as it throws light upon a large number of the most difficult problems of rural economy, of agricultural policy and also upon the trends in farming under the influence of variable market conditions.

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LIVE-STOCK INSURANCE IN GERMANY

THE following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

In the "Bulletin of Agricultural Economics and Sociology" the International Institute of Agriculture has published a study of live-stock insurance in Germany. In the first part, devoted to private insurance, are discussed the principal branches of this type of insurance, that is to say insurance against the death of live-stock, and insurance of slaughter animals. The articles discuss not only the origin and development of these forms of insurance, giving two complete statistical tables, but also that which concerns the insurance contract, the regulation of societies and legislation against live-stock diseases.

The second part is devoted firstly to public insurance of live-stock, practised in Germany, in Bavaria and Thuringia and by two Prussian public fire insurance companies and then to re-insurance of small local societies which has taken on various forms in Germany and which exists at the present time in Baden, Bavaria, the Free State of Saxony, and finally in Berlin under the form of a share company created recently by the agricultural corporation which owns the total capital of this society which has replaced several re-assurance organisations existing in several states.

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BIHAR VETERINARY COLLEGE, PATNA

The following notification has been received from the Principal, Bihar Veterinary College, Patna :—

The next session of the Bihar Veterinary College will commence from the 1st July. 1938.

1. A candidate desiring admission should submit his application on the prescribed form, together with the following certificates in original, so as to reach the Principal on or before the 1st June, 1938.

(*a*) Age and moral character certificate from the Headmaster of the school or Principal of the college which he last attended.

(*b*) University certificate or a certificate from the School or University authorities to show that he has passed the Matriculation Examination.

(*c*) Medical certificate of fitness from an Assistant Surgeon.

(*d*) Letter from his guardian stating that all expenses incurred by his ward during the latter's period of study at the college will be paid.

(*e*) Letter of identification from some well known person stating that the candidate is known to him and the statements made in the application form are correct.

2. A candidate for a District Board stipend to assist him while under training at the college should apply *in the first instance* to the Chairman of his home district board, with necessary certificates as soon as possible so that when selected he may be interviewed and approved by the Director of Veterinary Services, Bihar before he is recommended for admission. Such a candidate should in addition to the certificates required in para 1, produce at the time of admission a letter from the Director of Veterinary Services, Bihar, or the Chairman, District Board concerned regarding his selection as a stipendiary.

3. An applicant must be a Matriculate of a recognised University. Preference will be given to a candidate who has passed the I. A. or I. Sc. Examination. A good knowledge of English is essential. Height should not be under 5′ 4″ and chest unexpanded, not less than 30 inches. A candidate must not be below 16 and over 25 years of age.

4. A non-stipendiary candidate will have to appear before the Governing Body of the college when called for interview.

5. Fees must be paid in advance according to the scale under rule 8 of the college rules, the initial payment due at the time of admission being Rs. 35-8-0 only.

6. A candidate on admission will have to reside in the college hostel unless exempted under special circumstances.

7. Admission forms may be had free on application to the Principal. *Prospectus will be supplied on receipt of As. 4 by money order for each copy required.*

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STATISTICS OF THE PRODUCTION OF CERTAIN SELECTED INDUSTRIES IN INDIA

THE following statistics are reproduced from the "Monthly Statistics of the Production of Certain Selected Industries of India, for May, June, July and August, 1937."

Detailed statement of the quantity and description of jute manufactures produced in India

Description		Month of May		Month of June		Month of July		Month of August	
		1936	1937	1936	1937	1936	1937	1936	1937
I. Twist and Yarn	tons	3,979	3,793	4,303	4,387	4,662	4,502	4,459	4,533
II. Manufactures—									
Canvas	tons	227	309	223	300	221	264	175	306
	yds.	400,540	636,260	426,018	593,636	434,679	495,602	330,394	668,381
Gunny Bags—									
(a) Hessian	tons	5,469	4,802	6,130	5,307	6 772	5,024	5,530	4,366
	No.	11,144,627	11,373,243	11,396,533	11,393,721	12,980,150	10,057,495	11,069,935	9,047,982
(b) Sacking	tons	49,637	52,141	51,861	58,898	56,470	60,511	53,367	59,363
	No.	46,234,577	50,010,832	47,385,179	56,605,718	53,197,968	59,062,370	52,223,532	58,022,905
Gunny Cloth—									
(a) Hessian	tons	32,505	36,864	33,917	41,021	39,711	42,945	39,904	48,751
	yds.	125,732,311	142,430,307	131,773,875	158,547,567	151,814,618	165,751,092	153,238,966	168.668,724
(b) Sacking	tons	2,092	2,672	2,820	2,953	2,483	2,627	2,236	3,011
	yds.	4,713,841	5,957,286	6,401,183	6,660,839	5,508,689	6,263,635	5,229,152	7,291,480
Other Manufactures including Rope and Twine	tons	430	569	519	482	515	356	558	396
Total	tons	94,339*	101,150	99,773*	113,348	110,834*	116,229	106,229*	115,726
	yds.	130,846,892*	149,023,853	138,601,076*	165,802,042	157,757,986*	172,510,329	158,798,512*	176,628,585
	No. .	57,379,204*	61,384,075	58,781,712*	67,999,439	66,178,118*	69,119,865	63,293,467*	67,070,887

* Revised.

Detailed statement of the quantity and description of sulphuric acid produced in India

Description	Month of May		Month of June		Month of July		Month of August	
	1936	1937	1936	1937	1936	1937	1936	1937
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts	Cwts.
Sulphuric Acid—								
Ordinary or non-fuming	27,304*	58,458	37,477*	50,359	40,099*	42,127	54,410*	52,736

* Revised.

Detailed statement of the quantity and description of sulphate of ammonia produced in India

Description	Month of May		Month of June		Month of July		Month of August	
	1936	1937	1936	1937	1936	1937	1936	1937
	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons
Ammonium Sulphate—								
Neutral	1,231	1,280	949	1,260	986	1,327	1,283	1,497
Acid	160	50	585	...	473	52	182	33

Detailed statement of the quantity and description of sugar produced in India

Description	Month of May		Month of June		Month of July		Month of August	
	1936	1937	1936	1937	1936	1937	1936	1937
	Cwts.	Cwts	Cwts.	Cwts.	Cwts.	Cwts.	Cwts	Cwts
1. *Khandsari* Sugar*	(a) 6,717	4,037	(a) 3,160	1,661	(a)1,536	1,367	1,379	453
2. All other Sugar except Palmyra Sugar	(b)538,960	(b)1,653,015	145,882	222,690	(a) 147,824	77,719	166,957	109,847
3. Palmyra Sugar	(a) 5,991	1,020	6,601	1,954	19,589	5,669	31,286	30,504
Total	551,668	1,658,072	(a) 155,643	226,305	(a)168,949	84,755	199,622	140,804

* Figures relate to excised issues only. (a) Revised. (b) Excludes production in Burma.

Detailed statement of the quantity and description of wheat flour milled in India

Description	Month of May		Month of June		Month of July		Month of August	
	1936	1937	1936	1937	1936	1937	1936	1937
	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
Flour	429,159	503,758	391,565	452,719	437,699	540,835	500,149	559,349
Atta High grade	269,133	280,567	277,692	269,318	295,577	314,249	288,165	308,789
Atta Low grade	140,951	155,732	123,448	156,381	128,835	164,421	141,719	159,280
Bran	204,126	221,080	193,576	208,154	213,769	256,894	232,093	254,541
Soojee	37,985	59,198	38,535	63,672	41,855	73,705	48,054	64,066
Others	6,016	8,564	8,415	11,656	6,926	8,905	7,864	9,988
Total	1,087,370*	1,228,899	1,033,231*	1,161,900	1,124,661*	1,359,009	1,218,044*	1,355,903

*Revised.

ABSTRACTS

Inheritance of earliness in United Provinces rices, II. R. L. SETHI, B. L. SETHI and T. R. MEHTA. (*Ind. J. Agri. Sci.* **8**, 1)

THE results of a study of earliness made in four rice crosses with *sathi* rice as one of the parents have been described. Data up to the F_6 generation have been presented. The frequency distribution of flowering duration in F_2 was continuous and extended from the lower extreme of the early parent to well beyond the upper extreme of the later parent. The F_2 duration tended to be reproduced in the F_3 generation. The standard deviations of the flowering durations of the different F_3 families did not exhibit any relation to the corresponding mean values. The inheritance was governed by several cumulative genes. (*Authors' abstract*)

Cotton botany and the spinning value and hair properties of cotton lint. J. B. HUTCHINSON and G. K. GOVANDE. (*Ind. J. Agric. Sci.* **8**, 21)

THE technological data available for standard Indian cottons have been analysed according to botanical relationships. It is shown that the different botanical types differ greatly in mean spinning values and hair properties. The greatest differences are between the short, coarse, low-spinning *G. arboreum* var. *neglectum* forma *bengalensis* of northern India, and the other botanical groups. The other groups differ in hair weight, the Uplands being the finest and the *herbaceums* the coarsest, but have very similar hair lengths and spinning values.

The data show that the reputation of India as a producer of coarse-stapled cotton depends almost entirely on one of the four botanical types now cultivated. As it has already been shown that the coarse northern *arboreum* type has invaded most of the areas in which it now predominates in quite recent times, it is concluded that India has become a producer of coarse cottons by force of economic circumstances, and not on account of any inferiority in her indigenous cottons.

It is shown that the introduced Upland cottons differ very little from the superior indigenous types in spinning value. If adequate botanical and technological surveys are made of the range of variability available in the indigenous species, improvement in quality is likely to be attained as rapidly with them as with exotic types.

The relative importance of differences in crop variety, and in environment is examined, and it is shown that differences in hair properties and spinning value due to differences in environment are very small compared with those due to crop variety. Also, correlations between hair properties and spinning value are very much higher when calculated from differences in crop variety than from differences in environment. This is fortunate from the plant breeding point of view, since it minimises the errors which

will arise from the estimation of strain differences in spinning value from hair characters measured on small quantities of cotton from progeny rows.

The swollen-hair diameter method of determining fineness is discussed, and it is concluded that, if it is satisfactory after more extended trial, it will put the quantitative study of fineness within the reach of the plant breeder. Its importance is emphasised in enabling the plant breeder to select for high ginning percentage without the risk of loss of quality. (*Authors' abstract*)

Alternaria blight of cumin. B. N. Uppal, M. K. Patel and M. N. Kamat. (*Ind. J. Agric. Sci.* **8**, 49)

Alternaria blight of cumin occurs sporadically in the Kaira district in Gujarat. The disease attacks the aerial parts of the plant. In the early stages of attack the affected plants show minute, whitish necrotic areas which turn purple with age and later become brown and finally black. These areas are first exceedingly small in extent but, as they enlarge, become obliterated in the general invasion. The disease ultimately kills the affected parts, particularly the succulent leaves and blossoms. The attacked plants bear no seed, but, if some seed is produced, it is usually shrivelled, dark coloured and of poor germinability.

The fungus is extremely pathogenic on cumin, but failed to pass to other plants in cross-inoculation tests. The fungus is able to oversummer in plant residues in the field. It is probable that infected seed also plays an important part in the perennation of the fungus and in initiating primary infection.

The mycelium of the fungus produces the enzymes emulsin, trypsin, erepsin amylase, lipase and inulase. The morphology and cultural characters of the fungus are described. The fungus is considered to be a new species of *Alternaria* and is named *Alternaria burnsii*, with English and Latin descriptions. (*Authors' abstract*)

The *tur*-pod fly, *Agromyza obtusa* Mall, a pest of *Cajanus Cajan* Taskhir Ahmad. (*Ind. J. Agric. Sci.* **8**, 63)

The *tur*-pod fly, an important pest of *Cajanus Cajan* in several parts of India, has been identified as *Agromyza obtusa* Mall. Though distributed throughout the country it is serious only during winter and spring. During the year 1935-36 it was estimated that the maximum damage to *tur* pods at Pusa (Bihar) reached as high as sixty-three per cent.

Eggs are laid inside pods and the larvae on hatching bore into the seed and feed there till they are full grown. They pupate within the pod. During March and April the pre-imaginal period is about three weeks. The adult flies begin to copulate and oviposit almost immediately after emergence.

The activity of the pest is at a very low ebb during December and January when affected pods should be collected and burnt. A chalcid larval parasite has been noticed breeding in large numbers and seems to exercise considerable check on the activity of the pest in nature. (*Author's abstract*)

Studies in the preservation of fruit juices, I. Some observations on the preparation and preservation of citrus fruit squashes. LAL SINGH and GIRDHARI LAL. (*Ind. J. Agric. Sci.* **8**, 77)

ON the basis of analyses of samples of eighteen different brands of citrus squashes available in the market, various sets of orange and lemon squashes with different sugar concentrations (35°, 45° and 65° balling strength) preserved by different methods of preservation, were prepared and stored at room temperature for a period of 1½ year. Their behaviour during storage has shown that:—

1. Citrus fruit squashes with high sugar content (65°B) retain their fresh-fruit character and stability to a marked degree.
2. Addition of thoroughly ground and strained peel emulsion of two to four per cent fruits used for juice extraction, considerably improves the flavour and aroma of the bottled product.
3. Preservation with sulphur dioxide yields a product superior in taste, flavour and odour to that preservd with sodium benzoate or Pasteurization.
4. For effective preservation, maximum permitted concentration of sulphur dioxide (350 p.p.m) can be fairly diminished (100—200 p.p.m.) in squashes with high sugar content.
5. An examination of samples of squashes occasionally opened and re-corked during summer has shown that the chemically preserved squash has far better keeping qualities than the Pasteurized squash.
6. Squashes other than those preserved with sulphur dioxide undergo marked colour changes (light, yellow to deep brown) in 1½ year's storage.

Method of preparation and standardization of orange and lemon squashes has been given, their recipes and cost of production have been worked out. (*Authors' abstract*)

A form of verminous ophthalmia in equines. P. R. KRISHNA IYER. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 3)

UNDER the name of 'periodic ophthalmia', a disease affecting the eyes of horses in the stud farms at Montgomery and Probynabad in the Punjab has been known for some years. The disease is of a recurrent nature and terminates in the affected animals becoming blind. The disease occurs at all times of the year, and no seasonal incidence has been observed. Mechanical irritation by flies and dust, bacteria and dietetic deficiency were suspected to be concerned in the causation, but these agents have been eliminated. Histopathological examination has revealed the disease to be of verminous origin, microfilaria being constantly present in sections of the affected eyes, and lachrymal glands. Intense eosinophilia, neutrophile and lymphocytic infiltration and fibroblastic activity are some of the other features seen. The transmitting agent appears to be a biting fly. From the morphological features and unsheathed character, the microfilaria appears to belong to some onchocercoid worm, but attempts at specific determination have so far failed. Experience gained so far tends to show that treatment with antimosan and other antimony preparations have an inhibitory effect on the progress of the condition. (*Author's abstract*)

A comparative study of the colostrum of the dairy cow and the dairy buffalo. V. Sivasubramanian and C. W. Dover. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 29)

The above study has been made on three Sindhi cows and three Murrah buffaloes maintained at the Imperial Dairy Institute Farm, Bangalore. Samples of colostrum, which were drawn from all the four quarters of the udder were taken immediately after calving, and every six hours for the first day after calving, every twelve hours for the next two days, and after twenty-four hours on the fourth day, by which time the milk was found to have become normal.

In view of the fact that colostrum is rich in globulin, which in turn is responsible for the transmission of the maternal antibodies to the young, a separate analysis of this protein was made.

Except in regard to the fat content the results follow about the same order in all the cases.

Buffaloes' colostrum is higher in specific gravity, acidity, sodium chloride, total solids, total protein, casein, albumin, globulin and ash than cows' colostrum, while in lactose it is lower.

In both animals there is a progressive fall in all the constituents except lactose which shows an increase and fat which is irregular.

Globulin constitutes the major part of the total protein of both kinds of colostrum soon after calving, and its decrease is more marked during the first twenty-four hours than during the remainder of the colostral period.

Buffaloes' colostrum changes to normal milk in about three days, while cows' colostrum takes about four days. (*Authors' abstract*)

The incidence of *Salmonella enteritidis* var. *dublin* in pyosepticaemia of calves in India. V. R. Rajagopalan. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 33)

An organism isolated from cases of pyosepticaemia in calves, by Mr. Shirlaw at Lahore, has been typed as *Salmonella enteritidis* var. *dublin*, after a detailed study of its morphological, cultural and biochemical properties, as also of its antigenic constituents. Its antigenic structure has been found to be IX : gp : —., by a series of serological analysis. This is the first time that the incidence of this organism is recorded in India. (*Author's abstract*)

A study of the mineral assimilation of growing calves. A. Viswanatha Iyer and N. Krishna Ayyar. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 43)

Eight bull calves fourteen to seventeen months old were selected and divided into two similar groups of four each. One group received the basal ration, which consisted of hay, guinea grass (green), wheat bran and groundnut cake and the other group in addition to the basal ration a supplement of thirty grms. of calcium phosphate. Three digestion and mineral balance experiments were carried out.

After seventeen weeks of feeding, the groups were reversed, the animals receiving the basal ration now got the mineral supplement.

From the digestibility figures, it becomes evident (1) that even with the larger intake of phosphoric acid, there has not been any change in the digestibility of protein, (2) that when the minerals are sufficient in the feed itself, a supplement of calcium phosphate does not show any visible effect except for the fact that the animals receiving the supplement retain more calcium and phosphorus in their systems. (*Authors' abstract*)

THE following abstracts of articles from the *Indian Forester* have been received from the President, Forest Research Institute, Dehra Dun, and are published here as they are of interest to agricultural workers :—

Afforestation of the Ridge at Delhi. R. N. PARKER (*Ind. For.* LXII (11) : Pp. 671—72. 1936)

DESCRIBES results of planting after sixteen years on the dry rocky "Ridge" at Delhi. Successful species are listed, *Prosopis juliflora* and *Acacia ferruginea* being among the best. (*M. V. Laurie*)

Village uplift and its connection with forestry. K. D. JOSHI (*Ind. For.* LXIII (1) : Pp. 34—36. 1937)

THE necessity for co-operation with the forest department and with local forest officers in village uplift schemes is emphasised. (*M. V. Laurie*)

Frost in the Central Provinces. C. M. HARLOW. (*Ind. For.* LXIII (1) : Pp. 1—14. 1937)

THE note gives details of the frosts which have damaged the teak forests of the Western Circle of the Central Provinces and Berar in recent years. Records of earlier frosts are also given. Attention is drawn to the apparent fact that frosts earlier than January do less damage than later frosts : the period of great danger seems to be after about the 10th January. Minimum temperatures recorded at Khandwa over a series of years are then examined and an attempt made to correlate them with the years in which serious frost damage has been known to occur. One aspect of the effect of such frosts on the normal forest undercurrent methods of management is then given. (*Author's abstract*)

Can you use a divining rod? H. G. CHAMPION. (*Ind. For.* LXIII (2): Pp. 89—92. 1937)

DESCRIBES the claims made by K. M. Muller, the European diviner to be able to map 'earth rays' and to explain growth variations by them. The claims were not substantiated under test (Fabricius) but ingenious explanations of the failures were put forward. (*M. V. Laurie*)

Ecology and culture of *kuth*. SHER SINGH. (*Ind. For.* LXI (2): Pp. 80—89/ 573—88. 1935 LXII (2): Pp. 80—89. 3 plates 1936)

'KUTH' (*Sassaurea lappa*) is predominantly moisture-loving. It grows in the birch and high level fir zones from 8,000 to 12,000 feet elevation in the Kashmir Himalayas. 10,000 to 11,000 feet is the zone for optimum growth. It is a mesophyte and likes the light shade of birch. It is very susceptible to grazing, and indicator plants of areas suitable for *kuth* but from which it has been exterminated by grazing are listed. *Kuth,* unlike its associates flowers late, in the month of August and even later at higher elevations. (*M. V. Laurie*)

A short note on *simul* plantations in Assam. J. N. DAS. (*Ind. For.* LXII (5): 1 plate. Pp. 257—60. 1936)

PLANTATIONS of *simul* (*Bombax malabaricum*) should not be made at a closer spacing than about 22 ft. × 22 ft. The final number of trees per acre for a mean girth at 4 ft. 6 in. of six feet is about 22 trees per acre equivalent to 44 ft. × 44 ft. espacement. The rotation for this size is about twenty-five years. (*M. V. Laurie*)

Note on *Lantana camara* in the Simla Hills. N. G. PRING. (*Ind. For.* LXII (10): Plate 1. Pp. 603--8. 1936)

LANTANA was introduced by missionaries at Sabathu during the 19th century, and was planted extensively as a hedge plant. It now occupies some 20 square miles in Baghal State. It does not occur higher than about 4,000 feet elevation. While generally regarded as a pest, it is a safeguard against over grazing and erosion, and may even be an asset. Attempts at eradicating it are described. (*M. V. Laurie*)

Indian plants reputed as fish poisons. M. B. RAIZADA and B. S. VARMA. (*Ind. For.* LXIII (4): Pp. 198—218. 1937)

FIFTY-THREE plants that are reputed to be used as fish-poisons in India are compiled in this paper. A brief description of each plant, its vernacular name, habitat, area of abundance, its part or parts that are used for the purpose and its chemical constituent are given in a tabular form. It is stated in the introduction how several fish-poisons have been used as insecticide. (*S. Krishna*)

REVIEWS

Insects and other Pests Injurious to the Production of Seed in Herbage and Forage Crops. By H. F. Barnes, Entomology Department, Rothamsted Experimental Station, Harpenden, England. (Herbage Publication Series Bulletin No. 20. Published by the Imperial Bureau of Plant Genetics, Herbage plants, Aberystwyth, Great Britain, June, 1937). Pp. 32 + iv. Price 2*s*. 6*d*.

The Bulletin gives an account of the insects and other pests injurious to the production of seed in herbage and forage crops. The paper is divided into two sections, that dealing with grasses and that dealing with legumes. Insects which have come to the notice of seed producers in the general care of the plants, *i.e*, those causing indirect injury to seed production, those that directly cause the loss of seed and finally those which may from their habits become pests, are dealt with in this paper. In each case care is taken as far as possible to state the countries where the pests occur or are likely to do so, the nature of the damage, characters by which the insects may be recognised and control measures. Growers and others will find a considerable amount of information concerning the pests in this bulletin, but according to the author, advice regarding the actual safeguarding of crops should always be obtained by consulting local entolmologists The control measures mentioned indicate two main lines of approach, namely by the application of chemicals and by the slight alteration of cultural practices. The former and such other methods as trapping are of necessity only palliative. The latter are preventive and more to be desired both on account of their relative cheapness and more lasting effect. The author advocates intimate co-operation of the grower, agronomist and entomologist in the actual designing of control measures. [R. L. S.]

The Influence of Climatic Conditions on Type Composition. By Nils Sylven, Forage Crop Department, Plant Breeding Station, Svalöf, Sweden. (Herbage Publication Series Bulletin No. 21. Published by the Imperial Bureau of Plant Genetics, Herbage Plants, Aberystwyth, Great Britain, June, 1937), Pp. 8 + I plate. Price 1*s*.

The author has given four examples from different forage species such as white clover (*Trifolium repens*), red clover (*Trifolium pratense*), timothy (*Phleum*

pratense) and meadow fescue (*Festuca pratensis*), to clearly demonstrate the danger of growing strains for seed outside their special growing districts. According to the author this is specially the case if it is desired to keep up and further to fix those characters of strains which are specially adapted to the climatic conditions of the respective districts. He states that, when a forage crop strain has been bred within regions hardly adapted for seed production on a large scale, it is often necessary to transfer the main propagation of the strain to a more favourable place outside its natural growing district. The note is illustrated and lays emphasis on the fact that different natural selection caused by climatic conditions is a factor which must be taken into account. The experience of rational propagation of pure-bred herbage plant strains at Svalöf has definitely indicated that the longer a forage plant strain is grown outside its proper growing district, the greater must be the importance of this natural selection. [R. L. S.].

Technique of Grass Seed Production at the Welsh Plant Breeding Station. BY GWILYM EVANS, Officer in-charge of Seed Production, Welsh Plant Breeding Station, Aberystwyth (Herbage Publication Series Bulletin No 22. Published by the Imperial Bureau of Plant Gentics, Herbage Plants, Aberystwyth, Great Britain, August, 1937). Pp. 36+8 plates. Price 5*s*.

THE Bulletin contains a comprehensive description of the technique which has been evolved for producing seed of the various hay and grass pastures bred at the Station. The ground covered is fairly extensive and the subject is divided into six sections each giving a detailed account of different aspects of producing pasture strains. The initial stages of seed multiplication of a new grass strain is achieved by three stages, *i.e.*, the first from limited number of finally-selected plants, the second on a limited scale and the third in terms of several fields for each strain. In the first stage one of the first considerations is good isolation. This is chiefly achieved by means of glass houses. Alternative to this is to grow the original plants in the open and to have separate seed islands situated at distances from one another. An account of harvesting, threshing and cleaning as done for glass houses and the first multiplication grass island crops is given. Certain aspects of the second multiplication stage which require greater circumspection than in the third stage such as the selection of suitable growers and the optimum quantity of the seed grown per acre which varies not only with species and strains but also with the conditions under which particular strains grown are described. An account of the third multiplication stage follows next, and much valuable information is contained in this chapter. Starting with an account of selection of centres for growing pedigree seed to the last stage of storing of the seed, it gives

an interesting and illustrated account of the salient features connected with different aspects of the growth of the crop. The first section of this chapter deals with the difficulties encountered in the choice of districts. This is followed by a description of soil and climate most suited to the growing of satisfactory stocks of pedigree grass seed. Previous crops and what effect they have on (1) soil fertility, (2) general cleanliness of the land and (3) seed content of the soil are explained in the next section. The author states that an inquiry must be made into the cropping history of any particular field under consideration for seed growing. In order to be entirely satisfied that an area offered for stock seed growing is free from seeds likely to contaminate the seed crop, the soil must be sampled and the seed content examined by germinating seeds from such samples and growing the seedlings until the plants can be identified. According to the author, root crops in general supplied with generous quantities of organic manure appear to be most satisfactory as preparatory crops for grass-seed crops. The next section is devoted to field-management which covers a wide range of subjects and includes a description of methods and time of sowing, tilth, machinery employed for sowing and other operations, management in the seeding year, manures and fertilisers, grazing, stubble burning and roguing. There are two chief methods of sowing, (1) in drills and (2) in broadcast. The range of different dates for sowing different grasses and comparative value of nurse crops, including discussion on operations required in drill and broadcast stands under cover crops, are noted. Emphasis is laid on the need for working on the cleaning implements between the drills at frequent intervals during the seeding year in order to keep the weeds under control. Hand-hoeing is considered the most reliable method for relatively small areas of special stocks but this is found rather expensive for large areas. The comparative value of these as well as other methods employed for suppressing the weeds are described.

Grass species vary considerably in their need for fertilisers in relation to seed production. A full description of the comparative value of different fertilisers under different conditions is given. Unquestionably the master factor in any scheme of manuring grass for seed is nitrogen, whereas phosphates and potash are required to a much more limited extent. It is stated that in general terms it may be said that the more leafy the strain the higher should be the soil fertility. Of the species of grasses dealt with, the rye grasses are the most difficult as regards obtaining satisfactory seed yields from drills in successive years. Application of lime has been found to increase the longevity of such strains. The addition of farmyard manure seems to be indicated for the third seed crop at the latest, not only for plant nutrition but also to improve the mechanical condition of the land, water-holding capacity of lighter soils and drainage in the heavier soils. Broadcast areas of grasses grown for pure seed make greater demands on fertilisers than drill sowings of the same grasses. The proper times of operations like grazing

of grass seed islands, stubble burning and roguing are given. Greater emphasis is laid on obtaining clean crops on the field than on expensive cleaning machinery capable of removing any and every sort of impurity from the seed. An account of the indications of maturity of different grass species and strains, suitable time of harvesting, harvesting machinery, field conditioning, and stacking is given in the section on harvesting which follows next. According to the author, ripening is delayed when the stand is poorly developed in the previous autumn and also by such factors as heavy soils and wet summers. Post-harvest treatments such as threshing, hulling, conditioning of the seed, seed cleaning and storing are described in a separate section. The Station sends out a team of four men with a peripatetic thresher driven by an 8 H. P. Semi-Diesel engine during the end of July or the first week of August to begin threshing the early seed crops harvested in different counties. The thresher is constructed specially for the work of dealing with the pedigree stocks. Moisture being responsible for deterioration of seed in store, attempts have been made to keep the moisture content below 14 per cent—a percentage which is considered safe for keeping the seed in bags. A moisture-testing machine is used to determine almost instantaneously whether a threshed seed has sufficiently low moisture content to justify leaving it in bags after threshing. Measures adopted to dry the seed and pests appearing in the stored grass seeds with methods to deal with them effectively are described. The method of maintaining successive seed crops in good conditions is explained. According to the author thorough cultivation, manuring and good management are essential to maintain seed productivity for a number of years. An account of crops to follow the grass crop is also given. Abandoned drills is the first problem which confronts the seed growers and the methods to deal with the buried stubble effectively are described. The bulletin contains a brief statement of a new scheme for marketing seed of the strains bred at the station, in which collaboration will be assured between the station on the one hand and the seed trade and the Growers' Association on the other; a complete scheme of inspection and certification will be incorporated. The final section gives a list of the strains released by the station with a brief statement of the characteristics of each.

The importance of this latest contribution to the knowledge of production of new grass seed and management of the grass land from the world-known Welsh Station cannot be over-estimated, especially in view of the wide spread interest which is being awakened in dairy farming and improving pastures in general in India. Sir John Russell and Dr. Wright both drew attention to the necessity of an increase in the amount of grass available and extended experimental work on management of grass land in their reports. The Bulletin is thus a most welcome addition to the literature available on the subject and giving as it does the latest technique employed in growing grasses, will be found useful by those interested in the subject. [R. L. S.].

Collection of Native Grass Seed in the Great Plains, U. S. A. By F. J. Crider, Head, Section Conservation Nurseries, Soil Conservation Service, U. S. Department of Agriculture, Washington, D.C., and M. M. Hoover, In-charge, Grass Unit Conservation Nurseries, Soil Conservation Service, U. S. Department of Agriculture, Washington, D. C. (Herbage Publication Series Bulletin No. 24. Published by the Imperial Bureau of Plant Genetics, Herbage Plants, Aberystwyth, Great Britain, September 1937). Pp. 8+7 plates. Price 2*s*.

This paper gives an illustrated account of the typical grasses of the Great Plains which are being collected in connection with the soil conservation programme. While all problems associated with the quantity collection of the native grass seed have not been satisfactorily solved, enough experience has been gained and sufficient progress has been made to furnish a practical basis for the collection of the major species. Most local species "shatter" soon after ripening, which makes the period of harvest much shorter than that of cultivated grasses. This difficulty is overcome in part by the use of special machinery capable of harvesting considerable quantities of seed in a short time. Most noteworthy of these devices is the power stripper which can harvest twenty-five to thirty acres per day for each unit. These strippers because of their self-mobility and ease of height adjustment are found to be the most practical type of equipment for this work. In addition to the quantity collection of native seed, a number of nurseries have been established in the Great Plains for growing some of the more promising species and strains of both local and introduced plants for seed production. The seed and plant collectors are urged to keep constantly on the look-out for plants which may be an improvement over those now being used. This may include kinds which, because of special properties such as soil binding, ground cover, drought resistance, simplicity of propagation or ease of harvesting, are especially valuable for use in wind or water erosion control. More than a thousand species and strains have been collected in this way some of which are promising. To supplement statements given in the paper, photographs with descriptive information are appended which clearly indicate the type of grasses and machinery employed for harvesting. The publication will be of particular interest to persons in the more arid grass land regions where erosion is a problem. [R. L. S.].

Comparative Tests on the Utility of Pneumatic-tyred and Steel-tyred Carts (Conducted at the University of Reading Farm, Sonning). By J. B. Passmore and M. H. R. Soper. (Reprinted from the Bulletin of the Rubber Growers' Association, October 1937).

The note records the results of the final test carried out at the University of Reading Farm at Sonning on the 13th April 1937. The chief feature of the

method adopted consisted of the application of a dynamometer for registering the reading of the average draught requirements of different carts. Readings were taken over a distance of roughly 200 yards on a grass field and an unploughed field from which mangolds had been carted during the winter. The results show that (1) roller bearings did not appear to make much difference and (2) that pneumatic tyres reduced the draught over soft ground sufficiently to give a considerable saving in horse power. The note is illustrated, and in view of the fact that trials for testing the comparative merits of pneumatic-tyred and iron or wooden-tyred country carts are being carried out in India, the information will be found useful. [R. L. S.]

Agricultural Marketing in India. BY B. B. MUKERJEE, M.A., Department of Economics, Patna College, Patna. (Thacker Spink and Co., Ltd., Calcutta, 1937). Pp. 259, bibl. 60. Price Rs. 4-8-0.

AN attempt has been made in this book to offer a comprehensive study of the different aspects of marketing based on five years' personal investigations in the principal marketing centres of India. The book covers a wide range of subjects extending over fourteen chapters and discusses almost all important aspects of marketing. Various types of middlemen and their methods of working in different provinces are discussed in the first chapter. The author shows how the cost of distribution can be reduced by organising different services and making them more direct. A chapter is devoted to the description of markets in India. Laws regulating the markets, attempts made in recent years to improve them and the method of sale of different commodities in them are described. Market finance is also discussed and an account of the short-period loans and their sources which figure so prominently in the rural indebtedness in India is given. The problem of marketing in India is all the more complicated owing to the bewildering diversity of the weights and measures used in different parts of the country. The author gives a brief survey of the various weights and measures adopted in different parts and shows in a clear manner that orderly marketing is not possible without their standardisation. A chapter is devoted to various methods of storing different commodities.

The author has devoted a chapter to the question of adulteration carried out in different commodities. Stress is laid on standardisation and grading. Transportation by rail and road and its attendant difficulties form the subject matter of another chapter. 'Futures' trading as is carried on in principal commodities in a few important markets is described. An account of agricultural prices and the factors influencing them is given. Stress is also laid on the employment of the co-operative principle in the process of marketing. A brief survey of some

of the leading co-operative organisations in India is made and measures on which the success of co-operative marketing depends are described. Examples of successful attempts made in some places to link up producers and consumers—so often set against one another in sharp conflict—in a harmonious relationship calculated to promote the interests of both are given. The relationship of the State to marketing is discussed in another chapter and an account of the relative merits of different measures adopted in other countries for helping the agriculturists is given. In the end, a brief survey of the measures adopted by the Government of India in the direction of improvement of marketing is made.

The improvement of marketing organisation is very essential for the amelioration of the economic conditions in which agricultural produce is marketed in different parts of the country. Extracts from various reports of the Chambers of Commerce and registered trade associations are also given. The book will thus be found useful by those who are interested in the subject. [R. L. S.].

A Review of the Literature on Stock-scion Incompatibility in Fruit Trees, with particular reference to Pome and Stone Fruits. By G. K. Argles (Foreword by Prof. V. H. Blackman, Sc.D., F.R.S.). (Technical Communication No. 9 of the Imperial Bureau of Fruit Production, East Malling, Kent, England, 1937). Pp. 115, bibl. 194. Price 5*s*.

The problem of incompatibility has loomed ever larger with the increasing realization of the advantages to be gained by the use of tested clonal rootstocks for the production of uniformly excellent fruit.

The literature on the subject is considerable, but it is scattered over very many journals, bulletins and books, and is not always easy to follow. In it the term "incompatibility" is used extremely loosely and may mean much or little. The author here briefly summarizes the phenomena which occur as the result of slight or pronounced incompatibility in different stock-scion combinations.

The horticulturist is often faced with the problem of growing varieties of fruit in localities where there is no experience to guide him. If he knows that under certain conditions, which may in some respects resemble his own, certain rootstocks have given promising results with particular varieties, at least he has something on which to base his trials. He would be most unfortunate if, as regards the common deciduous tree fruits of commerce, he did not find some guidance in these pages.

The physiologist, moreover, has in this common feature of practical horticultural practice a unique investigational field at his disposal. The author gives him a firm basis on which to work.

First, the manifestations or symptoms of incompatibility in fruit trees are considered and their possible causes discussed. Next the compatibility or incompatibility shown by individual varieties of common diciduous fruit trees in respect of particular rootstocks is noted, considerable attention being paid to the practical field experience of research workers in different parts of the world with particular scions and rootstocks.

Certain general conclusions are drawn with regard to both the symptoms and the cause of inherent incompatibility, and tentative suggestions are made for drawing up a research programme to investigate the problem.

In an appendix, covering forty pages, are tabulated the many and often contradictory records of compatibility and incompatibility between particular rootstocks and particular varieties. They should prove helpful not only to the physiological investigator but also to the practical horticulturist.

NEW BOOKS

On Agriculture and Allied Subjects

Manual of the Grasses of the West Indies. By A. S. Hitchcock, Misc. Pub. No. 243, U. S. Dept. Agric., Washington, 1936, pp. 439.

The Biological Control of an Insect in Fiji—an account of the coconut leaf-mining beetle and its parasite complex. By T. H. C. Taylor, M.Sc. (Lond.) Royal 8vo, pp. x and 239, with 23 plates, 2 maps, and 17 text figures. (The Imperial Institute of Entomology, 41, Queen's Gate London, S. W. 7) 1937.

Bound in cloth price 12*s*. net. Postage inland 6*d*., abroad 10*d*.

Cacti—A Gardener's Handbook for their Identification and Cultivation. By J. Borg, M.A. M.D., late Professor of Natural History in Malta University. (MacMillan and Co., Ltd., London, W. C. 2.) 21*s*. net.

Principles and Methods of Tree-Ring Analysis. Pub. No. 486. By Waldo S. Glock with a foreword by A. E. Douglass and a contribution by G. A. Pearson. (Carnegie Institution of Washington, Washington, D. C.) Price $2·00 in paper, $2·50 in cloth.

Methods in Plant Physiology—A Laboratory Manual and Research Handbook. By Walter E. Loomis, Ph.D., Associate Professor of Plant Physiology and Research Associate, Iowa State College, and Charles A. Shull, Professor of Plant Physiology, University of Chicago, with a chapter on statistical methods by George W. Snedecor, M. S., Professor of Mathematics and Director of the Statistical Laboratory, Iowa State College. 472 pages, 94 illustrations, (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W. C. 2.) 25/- net.

Phytohormones. By F. W. Went, Ph.D., Professor of Plant Physiology, California Institute of Technology and K. V. Thimann, Ph.D., Assistant Professor of Plant Physiology, Harvard University. (MacMillan and Co., Ltd., London, W. C. 2.) 17*s*. net.

Climate: A Treatise on the Principles of Weather and Climate. By W. G. Kendrew. (Oxford University Press Amen House, Warwick Square, London, E. C. 4.) Second Edition, 15*s*. net. (provisional).

A Guide to Veterinary Parasitology for Veterinary Students and Practitioners. By T. Southwell, D.Sc., Ph.D., and A. Kirshner, M.B., Ch.B., D.T.M. (London: H. K. Lewis & Co., Ltd.) Price 7*s*. 6*d*. net.

Malkmus' Clinical Diagnosis of the Internal Diseases of Domestic Animals. English Translation revised by J. R. Mohler, V.M.D., D.Sc., and Adolf Eichorn, D.V.S. (Baillière, Tindall and Cox, London, W. C. 2). Price 15*s*.

Veterinary Pharmacology—Materia Medica and Therapeutics. By Prof. Howard Jey Milks, D.V.S. (Bailliere Tindall & Cox, London, W. C. 2.) Price 30*s*.

A History of Pharmacy. By James Grier, M.Sc., Ph.D., formerly Senior Lecturer in Pharmacy, Victoria University of Manchester. (London : Pharmaceutical Press. 1937). Price 6*s*.

The Digestive Tract. By A. E. Barclay. (Cambridge University Press). 36*s*. net.

The Genetics of Sexuality in Animals. By F. A. E. Crew. (Cambrid University Press). 10*s*. 6*d*. net.

The Intelligence of Animals. By G. C. Grindley, M. A., B.Sc. (Methuen 6 Essex Street, London, W. C. 2). 2*s*. 6*d*. net.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

BRITISH INDIA

Notification No. F. 46-11/38-A., dated the 17th March 1938, issued by the Government of India in the Department of Education, Health and Lands.

In modification of this Department Notification No. F. 116-34-A., dated the 8th April 1937, it is notified for general information that no fee will be charged for consignments of plants and fruits intended for export to countries abroad when the work of inspection and certification is done at Karachi by an officer stationed at that place. A fee of Rs. 20 will be charged for each consignment only when an officer has to be called from outside Karachi to make the examination.

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

Imperial Council of Agricultural Research

His Excellency the Governor-General in Council has been pleased to appoint the Hon'ble Minister in charge of the Portfolio of Agriculture under the Government of Sind, to be a member of the Imperial Council of Agricultural Research and of its Governing Body.

Mr. L. Mason, C.I.E., O.B.E., M.C., Inspector-General of Forests has been nominated by the Central Government to be the representative of the Forest Research Institute, Dehra Dun, on the Imperial Council of Agricultural Research with effect from the 1st December 1937, *vice* Sir Gerald Trevor, C.I.E., resigned.

The services of Mr. F. Ware, C.I.E., F.R.C.V.S., I.V.S., Director, Imperial Veterinary Research Institute, are placed at the disposal of the Imperial Council of Agricultural Research with effect from the 7th May, 1938.

The Government of the Punjab have nominated Captain U. W. F. Walker, M.C., M.R.C.V.S., I.V.S., Director, Veterinary Services, Punjab, as the representative of the Punjab Veterinary Department on the Council, with effect from the 14th February 1938, *vice* Mr. T. F. Quirke, M.R.C.V.S., I.V.S., deceased.

Indian Central Cotton Committee

The Governor-General in Council has been pleased to appoint the Economic Botanist (Cotton) to the Government of the United, Provinces to be a member of the Indian Central Cotton Committee, with effect from the 16th November 1937 to the 30th September 1938.

Mr. M. S. Durutti (of Messrs. Ralli Brothers, Limited, Bombay) has been nominated by the Bombay Chamber of Commerce to be a member of the Indian Central Cotton Committee, Bombay, *vice* Mr. S. B. Samoilys, resigned.

Mr. J. C. McDougall, M.A., B.Sc., I.A.S., Director of Agriculture, Central Provinces and Berar, has been nominated by the Central Government to be a

member of the Indian Central Cotton Committee, to represent the Agricultural Department of that province, *vice* MR. R. H. HILL, M.A., resigned.

Indian Central Jute Committee

MR. G. C. LIMBOUSSI (of Messrs. Ralli Brothers, Limited) has been nominated by the Calcutta Baled Jute Association to be a member of the Indian Central Jute Committee, *vice* MR. EUTHYMOPULO, resigned.

MR. P. S. MACDONALD (of Messrs. Thomas Duff & Co., Ltd.) has been nominated by the Indian Jute Mills Association, Calcutta, to be a member of the Indian Central Jute Committee *vice* MR. G. M. GARRIE, resigned.

Indian Lac Cess Committee

The Governor-General in Council has been pleased to appoint MR. L. MASON, C.I.E., O.B.E., M.C., Inspector-General of Forests as a member of the Advisory Board of the Indian Lac Cess Committee, *vice* SIR GERALD TREVOR, C.I.E., resigned.

The Central Government have been pleased to appoint MR. W. F. DINES, (of Messrs. Angelo Brothers, Ltd.) nominated by the Bengal Chamber of Commerce, to represent the Shellac Manufacturing industry, as a member of the Governing Body of the Indian Lac Cess Committee, *vice* MR. J. P. YOUNG, resigned.

Madras

MR. A. C. EDMONDS, B.A., Dip. Agri. (Cantab.), Deputy Director of Agriculture, III Circle, Bellary, has been granted leave, out of India, on average pay for four months and twenty-nine days and in continuation thereof, leave on half average pay for six months and twelve days, with effect from the 6th April 1938 or date of relief.

Bombay

RAO SAHIB B. P. VAGHOLKAR, Principal Agricultural Officer, Sugarcane Research Scheme, Padegaon, has been granted leave on average pay for four months with effect from the 15th February 1938, or the subsequent date on which he may be relieved.

Bengal

Mr. P. J. Kerr, M.R.C.V.S., I.V.S., Veterinary Adviser to the Government of Bengal, has been granted leave for eight months with effect from the 22nd March 1938 or any subsequent date on which he may avail himself of it.

United Provinces

On return from leave Mr. T. J. Egan, M.R.C.V.S., I.V.S., has been posted to be the Director of Veterinary Services, United Provinces, with effect from the 11th November 1937.

Punjab

The Punjab Government record with deep regret the death of Mr. Thomas Francis Quirke, Director, Veterinary Services, Punjab.

Mr. Quirke was born in June 1891, at Tipperary, Ireland. After a preliminary education at Clongowes Wood College, Sallins, from 1905 to 1909, he entered the Royal Veterinary College, Ballsbridge, Dublin, and received his diploma of M.R.C.V.S. in 1913. He was employed in veterinary work in Ireland for two years; and came to India in February 1915, having been appointed to the Indian Civil Veterinary Department, now known as the Indian Veterinary Service. He served for some five years as a Superintendent in this Department at Ferozepore and Rawalpindi. In March, 1920, he was promoted to the post of Chief Superintendent in succession to the late Lt.-Col. Farmer. He became a specialist in the control of contagious diseases and in animal husbandry. In 1928, when the Veterinary Department was separated from the Agricultural Department, he was appointed Director of the new Department, and continued to hold this post until his death on January 13, 1938. He has thus been at the head of the veterinary work of the province for nearly eighteen years. During this period the veterinary Department of the Punjab has attained a growth and a fame unparalleled in India; and the Punjab Government gratefully acknowledge how large a share of this success was due to Mr. Quirke's unstinting efforts, wide knowledge and unfailing enthusiasm. Mr. Quirke was keenly interested in horse-breeding and did much to encourage it both in his official capacity and through his long connection with the Lahore Race Club. His early death has deprived the province of a sympathetic and experienced officer whose memory will be preserved in the enduring work which he did for the people of the province. Government deeply regret his loss and they and all with whom he worked, no less than his many personal friends, will long remember him with affection.

CAPTAIN U. W. F. WALKER, M.C., M.R.C.V.S., I.V.S., officiating Principal, Punjab Veterinary College, Lahore, has been appointed provisionally Director, Veterinary Services, Punjab, with effect from the 14th January 1938 *vice* MR. T. F.QUIRKE, M.R.C.V.S., I.V.S., deceased. CAPTAIN WALKER will continue to perform the duties of the post of the Principal, Punjab Veterinary College, in addition to his duties as Director, Veterinary Services, until further orders.

KHAN BAHADUR M. AFZAL HUSAIN, M.Sc., M.A. (Cantab.), I.A.S., Principal, Punjab Agricultural College and Entomologist to Government. Punjab, Lyallpur, has been granted leave on average pay for two months and twenty-one days with effect from the 20th January 1938, afternoon.

DR. P. E. LANDER, M.A. (Cantab.), D.Sc. (Lond.), F.I.C., I.A.S., Agricultural Chemist to Government Punjab, Lyallpur, has been appointed Principal, Punjab Agricultural College, Lyallpur, with effect from the 20th January 1938, afternoon *vice* KHAN BAHADUR M. AFZAL HUSAIN, granted leave.

DR. R. L. CHOPRA, M.A., Ph.D. (Wales), Assistant to the Entomologist, Lyallpur, has been appointed Entomologist to Government, Punjab, Lyallpur, with effect from the 20th January 1938 *vice* KHAN BAHADUR M. AFZAL HUSAIN, granted leave and in addition to his own duties.

Central Provinces and Berar

On return from leave, MR. J. C. MACDOUGALL, M.A., B.Sc., has been reposted as Director of Agriculture, Central Provinces and Berar.

On relief by MR. J. C. MACDOUGALL, MR. R. H. HILL, M.A. (Cantab.), officiating Director of Agriculture, Central Provinces and Berar, reverts to his substantive post of Deputy Director of Agriculture, Economics and Marketing, Central Provinces and Berar.

On relief by MR. R. H. HILL, M.A. (Cantab.), MR. P. D. NAIR, M.A., L.Ag. (Hons.) Post-Graduate, officiating Deputy Director of Agriculture, Economics and Marketing, Central Provinces and Berar, reverts to his substantive appointment as Assistant Director of Agriculture and will remain attached to the office of the Director of Agriculture, Central Provinces and Berar.

Assam

MR. FAZLUL HAQUE, Dip. Agri., Deputy Director of Agriculture, Upper Assam Valley, has been appointed to hold the temporary post of Deputy Director of Agriculture, Reconstruction, Assam, with effect from the 12th November 1937.

DR. H. K. NANDI, Ph.D., has been appointed on probation to the post of Economic Botanist, Assam, in class I of the Assam Agricultural Service, with effect from the date on which he assumes charge of his duties.

Orissa

MR. P. D. DIXIT, M.Sc., First Research Assistant in the Rice Research Scheme for Orissa has been appointed temporarily as Paddy Specialist in the scheme.

BURMA

CAPTAIN S. R. RIPPON, M.R.C.V.S., officiating Director of Veterinary Services, has been granted leave on average pay for one month and ten days combined with study leave in Africa for six months, with effect from the 1st March 1938 or the subsequent date on which he avails himself of it.

CAPTAIN S. R. RIPPON, M.R.C.V.S., and MR. D. T. MITCHELL, M.R.C.V.S., respectively, made over, and received, charge of the duties of the Director of Veterinary Services Burma, on the 8th February, 1938.

U. NYAN KYAW, G.B.V.C., Veterinary Superintendent, and CAPTAIN S. R. RIPPON, M.R.C.V.S., respectively made over and received charge of the duties of Deputy Director of Veterinary Services, Lower Burma Charge, Insein, on the 9th February 1938.

U. NYAN KYAW, G.B.V.C., Veterinary Superintendent, has been appointed temporarily to be Deputy Director of Veterinary Services, Lower Burma Charge, with headquarters at Insein, in addition to his own duties, as Veterinary Superintendent in charge of South Central Circle, in place of CAPTAIN S. R. RIPPON proceeding on leave.

Recent Publications of the Imperial Agricultural Bureaux

I. Obtainable from the Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden, Herts

Periodical Abstracts

	s.	d.
List of publications and papers on Soil Science published in the Empire Overseas in—		
1933	1	0
1934	1	0
Soil Research in the British Empire published in 1935	1	0
Lists of Publications relating to Soils and Fertilisers—		
Published monthly, per annum, post free	10	0
Monthly Letters—		
Free to recipients, within the British Empire, of "Publications relating to Soils and Fertilisers". Subscription, outside the Empire, per annum	4	0
Recent Developments in Soil Analysis—		
Quarterly Supplement to the above publications. Separate copies, each	0	6

Occasional Papers

	s.	d.
Technical Communications—		
34. Tropical Soils in relation to Tropical Crops	2	6
Annual Report : For the year 1933-34	0	6
,, 1934-35	0	6
,, 1935-36	0	6
Bibliographies—		
Bibliography on Coffee	2	0
Catalogue of Journals and Periodicals in the Library of Rothamsted Experimental Station	2	0
Special Publication—		
The Katamorphism of Igneous Rocks under Humid Tropical Conditions (by the late Sir J. B. Harrison)	5	0
Bibliography of Soil Science, Fertilisers and General Agronomy, 1931-34	25	0

II. Obtainable from the Imperial Bureau of Animal Health, Veterinary Research Laboratory, New Haw, Weybridge, Surrey

Abstracting Journal

	s.	d.
The Veterinary Bulletin—		
1931. Vol. 1. Quarterly (1st Number, April)	7	6
Annual subscription	20	0
Subsequent volumes. Monthly (1st Number, January)	5	0
Annual subscription (postage paid)	40	0

	s.	d.
Indexing Publication		
Index Veterinarius.—Four issues a year. First issue, April 1933. Annual Subscription (postage paid). Volumes I to III mimeographed, Volume IV onwards printed	100	0

III. Obtainable from the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Bucksburn, Aberdeen

Journal

Nutrition Abstracts and Reviews. (Issued under the direction of the Imperial Agricultural Bureaux Council, the Medical Research Council and the Reid Library)—		
Subscription per volume of 4 numbers	42	0
Per single number	13	0

Occasional Papers

Technical Communications—		
6. The Composition of Certain African Foods and Feeding Stuffs . .	1	0
7. Wheat. Pre-eminence as a Cereal Food : Nutritive Value ; Relation to Health and Disease.	1	0
Occasional Communications—		
1. The Effect of Climate on the Composition of Pasture Plants . .	..	

IV. Obtainable from the Imperial Bureau of Plant Breeding and Genetics Plant Breeding Institute, School of Agriculture, Cambridge

Journal

Plant Breeding Abstracts—		
Quarterly. Annual subscription	15	0
Single copy	5	0

Occasional Papers

Indexes to Plant Breeding Abstracts—		
Subject Index to Vols. I to V of Plant Breeding Abstracts	5	0
Subject Index to Vol. VI of Plant Breeding Abstract	2	6
Supplements to Plant Breeding Abstracts—		
Summary of Reports received from Countries exclusive of the British Empire, 1928-31. Supplement I	0	6
Summary of Reports received from Stations in the British Empire, 1932-35. Supplement II	5	0
Technical Communications—		
Vernalization and Phasic Development of Plants, 1935 (Joint Publication of the Imperial Bureaux of Plant Genetics)	10	0
The South American Potatoes and their Breeding Value	3	6
Bibliographical Monographs—		
Breeding Resistant Varieties, 1930-33 (Supplement)	2	0
The Experimental Production of Haploids and Polyploids	5	0

V. OBTAINABLE FROM THE IMPERIAL BUREAU OF PASTURES AND FORAGE CROPS WELSH PLANT BREEDING STATION, AGRICULTURAL BUILDINGS, ALEXANDRA ROAD ABERYSTWYTH, WALES

Journals

	s.	d.
Herbage Abstracts—		
Quarterly. Annual subscription	15	0
Single number	5	0

Herbage Reviews—

Subscription is at present—Vol. 1 (1933), Vol. 2 (1934), Vol. 3 (1935), Vol. 4 (1936)—included in that to Herbage Abstracts.

Occasional Papers

Bulletins—

18. Pastures and Forage Crops in South Africa	3	0
19. Production of Grass Seed	5	0
20. Insects and other Pests Injurious to the Production of Seed in Herbage and Forage Crops	2	6
21. The Influence of Climatic Conditions on Type Composition	1	0
22. Technique of Grass Seed Production at the Welsh Plant Breeding Station	5	0
23. Production of Legume Seed	5	0
24. Collection of Native Grass Seed in the Great Plains, U. S. A.	2	0

VI. OBTAINABLE FROM THE IMPERIAL BUREAU OF HORTICULTURE AND PLANTATION CROPS, EAST MALLING RESEARCH STATION, EAST MALLING, KENT

Journal

Horticultural Abstracts—

A quarterly abstract publication of current horticultural literature—

Annual subscription	15	0
Single copy	4	0

Technical Communications

7. Vegetative Propagation of Tropical and Sub-tropical Fruits, 1936. J. St. Clair Feilden and R. J. Garner	2	0
8. Horticultural Aspects of Woolly Aphis Control together with a Survey of the Literature, 1936. R. M. Greenslade	2	6

Occasional Papers

3. Annotated Bibliography on Bitter-Pit, 1934	1	6
4. Recent Work of Tropical and Sub-Tropical Interest	0	6

O

	s. d.
Other Publications—	
Index to Volumes I-X of the *Journal of Pomology and Horticultural Science*, 1933. Compiled by Bureau, published by the Editors of the *Journal of Pomology and Horticultural Science*. Available from the Bureau	5 0
Old and New Standpoints on Senile Degeneration, 1931. A. P. C. Bijhouwer	0 6
Fruit Growing in the Empire. Standardisation of Horticultural Material with special reference to Rootstocks, 1927. R. G. Hatton. Being unnumbered Empire Marketing Board Publication. (Free).	
Viticultural Research, 1928. D. Akenhead. Being Empire Marketing Board Publication 11	1 0

VII. Obtainable from the Imperial Bureau of Animal Breeding and Genetics, Institute of Animal Genetics, University of Edinburgh, King's Buildings, West Mains Road, Edinburgh

Journal

Animal Breeding Abstracts (quarterly), commencing April, 1933. Annual subscription	15 0

Occasional Papers

Bibliography of the Works of J. C. Ewart (free to subscribers of Animal Breeding Abstracts, Vol. 1), 1934	0 6
Animal Breeding in the British Empire A Survey of Research and Experiment, 1934	2 0

VIII. Obtainable from the Imperial Bureau of Agricultural Parasitology (Helminthology), Institute of Agricultural Parasitology, Winches Farm Drive, Hatfield Road, St. Albans, Herts

Journal

Bibliography of Helminthology. For the year 1933—	
Library Edition, bound in cloth	10 6
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Occasional Papers

(*i*) The Effects of some Natural Factors on the Second Ecdysis of Nematode Infective Larvae. G. Lapage	4 0
Notes and Memoranda—	
11. Recent Developments in the Control of *Heterodera marioni* . .	1 6

PUBLICATIONS ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY, 41 QUEEN'S GATE LONDON S. W. 7

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Published annually about July in each year and containing as complete a record as possible of the literature of the previous year, chiefly from the systematic standpoint.	
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PUBLICATIONS OBTAINABLE FROM THE IMPERIAL MYCOLOGICAL INSTITUTE, KEW, SURREY

Journal

Review of Applied Mycology –	
Annual subscription, 12 monthly parts, with title-page and index (post free)	
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Title-page and index	3 0
Report on the Third Imperial Mycological Conference, 1934 . .	2 0

List of Agricultural Publications in India from 1st August 1937 to 31st January 1938

Title	Author	Where published
GENERAL AGRICULTURE		
Agriculture and Live stock in India, Vol. VII, Parts 5 and 6 and Vol. VIII, Part 1. Annual subscription Rs. 6 or 9 *s*. 9*d*. (A bi-monthly Journal of agriculture and animal husbandry for the general reader interested in agriculture or live-stock in India or the Tropics)	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Civil Lines, Delhi
The Madras Agricultural Journal. Monthly. Annual subscription Rs. 4	K. Ramiah (Editor). Published by the M. A. S. Union, Agricultural Research Institute, Coimbatore	The Secretary, M. A. S. Union, Agricultural College, Lawley Road, P. O.
The Journal of the Trichinopoly District Agricultural Association (English and Tamil). Quarterly. Annual subscription Re. 1-8-0 for non-members, free for members	Issued by the Trichinopoly District Agricultural Association, Teppakulam Post	The Secretary, The Trichinopoly District Agricultural Association, Teppakulam Post
The Journal of the Mysore Agricultural and Experimental Union (English). Quarterly. Price As. 13 or 1 *s*. 3 *d*. per copy	Dr. V. K. Badami (Chief Editor)	The Secretary, the Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore
Mysore Vyavasaya Shodhaka Sanghada Patrike (Monthly). Price As. 4 per copy	N. Vankatasubbaiya (Chief Editor)	Ditto
The Poona Agricultural College Magazine. Quarterly. Annual subscription Rs. 2-8-0	V. G. Deshpande and S. M. Rao, (Editors)	The Editor, *Poona Agricultural College Magazine*, Poona
Shetki Shetkari (Marathi). Monthly. Annual subscription Re. 1-3-0	Vasudev Ganesh Pande	The Editor, *Shetki Shetkari*, Agricultural College, Poona
The Planters' Journal and Agriculturist. Fortnightly. Annual subscription Rs. 10 or 16 *s*.	Theo H. Thorne (Editor)	The Manager, *The Planters' Journal and Agriculturist*, 13, Ezra Mansions, Calcutta
Krishi-sampad (Bengali). Monthly. Annual subscription Rs. 3	N. K. Ghosh (Editor)	The Manager, *Krishi Sampad* Office, Dacca

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
The Mufidul Mazarin (Urdu) Annual subscription Re. 1 for subscribers in United Provinces and Re. 1-8-0 for subscribers outside the province	C. C. Sanyal, (Editor) Government Agricultural Journals	Office of the Editor, Government Agricultural Journals, Sikandar-Bagh, Lucknow
The Kisan Upkarak (Hindi). Annual subscription Re. 1 for subscribers in United Provinces and Re. 1-8-0 for subscribers outside the province	Ditto .	Ditto
The Allahabad Farmer. Bi-monthly. Annual subscription in India Rs. 2	B. M. Pugh (Editor). Published by the Agricultural Institute, Allahabad	The Allahabad Agricultural Institute, United Provinces (American Presbyterian Mission), Allahabad
Seasonal Notes. Price As. 4 per copy	Issued by the Department of Agriculture, Punjab	Government Printing, Punjab, Lahore
The Nagpur Agricultural College Magazine. Quarterly. Annual subscription Rs. 3	Published by P. D. Nair, Agricultural College, Nagpur	The Editor, *The Nagpur Agricultural College Magazine*, College of Agriculture, Nagpur
Kisan (Hindi). Quarterly. Annual subscription Rs. 2. As. 8 per copy	Issued by the Agricultural Association, Bihar and Orissa	B. N. Sircar, Senior Marketing Officer and Editor, *Kisan*, Patna
Agriculture and Animal Husbandry in India, 1935-36. Price Rs. 4-10-0 or 7 *s*. 9 *d*.	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Civil Lines, Delhi
Report of the Work of the Imperial Council of Agricultural Research in applying Science to Crop Production in India. Price Rs. 1-14-0 or 3 *s*. 3 *d*.	Sir John Russell, D.Sc., F.R.S.	Ditto
Report on the Cold Storage and Transport of Perishable Produce in Delhi. Price As. 12 or 1 *s*. 3 *d*.	Agricultural Marketing Adviser to the Government of India	Ditto
Summary Proceedings of the 34th Meeting of the Indian Central Cotton Committee. Price Re. 1	Issued by the Publicity Officer, Indian Central Cotton Committee, Bombay	Indian Central Cotton Committee, Bombay
Garrowhill Cotton and the Central Provinces Cotton Control Act Prohibiting its Cultivation. (English, Hindi and Marathi). *Gratis*	Ditto .	Ditto

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Cholam Malt (English, Tamil and Telugu) (Reprint). Leaflet No. 4 of the Department of Agriculture, Madras	M. Suryanarayana	Government Press, Madras
Care and Management of Cattle-manure in South India (English, Telugu, Tamil, Kanarese and Malayalam) (Reprint). Leaflet No. 24 of the Department of Agriculture, Madras	V. Muthuswamy Ayyar	Ditto
The Earth Scoop (Telugu, Tamil, Kanarese and Malayalam). Leaflet No. 78 of the Department of Agriculture, Madras	N. G. Charley	Ditto
Improved Turmeric Polisher (Tamil, Telugu, Kanarese and Malayalam). Leaflet No. 80 of the Department of Agriculture, Madras	Ditto	Ditto
Manufacture of Active Carbon from Paddy Husk (English, Telugu, Tamil, Kanarese and Malayalam). Leaflet No. 81 of the Department of Agriculture, Madras	P. V. Ramiah	Ditto
Evils of Damping Groundnut (English, Telugu, Tamil, Kanarese and Malayalam). Leaflet No. 83 of the Department of Agriculture, Madras	J. S. Patel	Ditto
Note on Nilgiri Agriculture (Kanarese). Pamphlet No. 10 of the Department of Agriculture, Madras	D. G. Munro	Ditto
A. H. 25 Improved Groundnut (English). Pamphlet No. 12 of the Department of Agriculture, Madras	J. S. Patel	Ditto
Plough Early (English). (Reprinted). Broad Hint No. 3 of the Department of Agriculture, Madras	Rao Bahadur D. Ananda Rao	Ditto

Title	Author	Where published

GENERAL AGRICULTURE—*contd.*

Plough Efficiently (English). (Reprinted). Broad Hint No. 4 of the Department of Agriculture, Madras	Rao Bahadur D. Ananda Rao	Government Press Madras
Sow Good Seed (English). (Reprinted). Broad Hint No. 5 of the Department of Agriculture, Madras	G. R. Hilson . .	Ditto
Beware of Weeds (English). (Reprinted). Broad Hint No. 6 of the Department of Agriculture, Madras	Ditto . . .	Ditto
Annual Report of the Department of Agriculture, Bengal for 1936-37. Part I, price As. 8; Part II price Re. 1-4-0	Issued by the Department of Agriculture, Bengal	Superintendent, Government Printing, Bengal
A Short Survey of the Work, Achievements and Needs of the Bengal Agricultural Department for the period 1906-1936. Free (For official use only)	Ditto .	Office of the Director of Agriculture, Bengal, Dacca
Instructions for Sowing Improved Varieties of Rice Seed (Reprinted). Leaflet No. 36 of the Department of Agriculture, United Provinces. (Free in U. P. only)	Rai Bahadur R. L. Sethi	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Eastern Circle, Partabgarh 3. Deputy Director of Agriculture, Western Circle, Aligarh 4. Deputy Director of Agriculture, North Eastern Circle, Gorakhpur 5. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
The Utilization of Molasses as a Manure (Urdu and Hindi). Leaflet No. 41 of the Department of Agriculture, United Provinces, (Free in U. P. only)	Department of Agriculture, United Provinces	Ditto
Lawn Making (Urdu). Leaflet No. 48 of the Department of Agriculture, United Provinces, (Free in U. P. only.)	Ditto	Ditto
Seed Sowing (Urdu). Leaflet No. 49 of the Department of Agriculture, United Provinces. (Free in U. P. only)	Ditto.	Ditto

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Hedges (Urdu). Leaflet No. 50 of the Department of Agriculture, United Provinces. (Free in U. P. only)	Department of Agriculture, United Provinces	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture Eastern Circle, Partabgarh 3. Deputy Director of Agriculture, Western Circle, Aligarh 4. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur 5. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
Rose Cultivation (Urdu). Leaflet No. 51 of the Department of Agriculture, United Provinces. (Free in U. P. only)	Ditto .	Ditto
Other Important Matters about Seeds (Urdu). Leaflet No. 52 of the Department of Agriculture, United Provinces. (Free in U. P. only)	Ditto .	Ditto
Paddy Cultivation in Canal Tracts (English), Leaflet No. 66 of the Department of Agriculture, United Provinces. (Free in U. P. only)	Ditto .	Ditto
The Cultivation of *Ajwain* (English). Leaflet No. 67 of the Department of Agriculture, United Provinces. (Free in U. P. only)	Ditto .	Ditto
Cultivation of Some Important Drugs in the Punjab. Price As. 10	Issued by the Department of Agriculture, Punjab	Superintendent, Government Printing, Punjab, Lahore
L. S. S. A New Cotton of Hirsutum Type. Leaflet No. 139 of the Department of Agriculture, Punjab. Free	Ditto .	Ditto
Annual Report of the Department of Agriculture, Bihar for the year 1936-37. (In the press)	Issued by the Department of Agriculture, Bihar	Government Printing, Bihar, Gulzarbagh
Annual Report of Tirhut Range. Bulletin No. 3 of 1937 of the Department of Agriculture, Bihar	Ditto .	Ditto

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Annual Report of Patna Range. Bulletin No. 4 of 1937 of the Department of Agriculture, Bihar	Issued by the Department of Agriculture Bihar	Government Printing, Bihar, Gulzarbagh
Annual Report of Bhagalpur Range. Bulletin No. 5 of 1937 of the Department of Agriculture, Bihar	Ditto .	Ditto
Annual Report of Chota Nagpur Range (In press). Bulletin No. 6 of 1937 of the Department of Agriculture, Bihar	Ditto .	Ditto
Annual Report of the Engineering Sections. Bulletin No. 9 of 1937 of the Department of Agriculture, Bihar	Ditto	Ditto
Soya Bean—Its Cultivation and Use. Leaflet No. 5 of 1937 of the Department of Agriculture, Bihar	Ditto .	Ditto
Report on Demonstration Work carried out in Northern Circle together with Reports on Seed and Demonstration and Cattle-breeding Farms of the Circle for the Year ending the 31st March 1936. Price Re. 1-8-0	Issued by the Department of Agriculture, Central Provinces and Berar	Government Printing, Central Provinces and Berar, Nagpur
Report on Demonstration Work carried out in the Eastern Circle together with Reports on Seed and Demonstration and Cattle-breeding Farms of the Circle for the Year ending the 31st March 1936. Price Re. 1-8-0	Ditto .	Ditto
Report on Demonstration Work carried out in the Western Circle together with Reports on the Seed and Demonstration and Cattle-breeding Farms of the Circle for the Year ending the 31st March 1936. Price Re. 1-8-0	Ditto .	Ditto
Report on Demonstration Work carried out in the Southern Circle together with Reports on Seed and Demonstration and Cattle-breeding Farms of the Circle for the Year ending the 31st March 1936. Price Re. 1-8-0	Ditto .	Ditto
Demonstration Plot, Kham. (English, Hindi, and Marathi). Leaflet No. 15 of 1937 of the Department of Agriculture, Central Provinces and Berar. (Free)	Ditto .	

Title	Author	Where published
GENERAL AGRICULTURE—*concld.*		
Eradication of *Kans* by Cultivated Fallow System (English, Hindi and Marathi). Leaflet No. 16 of 1937 of the Department of Agriculture, Central Provinces and Berar. Free	Issued by the Department of Agriculture, Central Provinces and Berar	Government Printing, Central Provinces and Berar, Nagpur
Eradication of *kans, kunda, dub* and *nagarmotha* (English). Leaflet No. 17 of 1937 of the Department of Agriculture, Central Provinces and Berar. Free	Ditto . .	Ditto
Catch Crop for Orissa (Oriya). Bulletin No. 8 of 1937 of the Department of Agriculture, Orissa	Issued by the Director of Development, Orissa	Orissa Government Press, Cuttack
Annual Experimental and Research Report of Hyderabad-Deccan for 1344 Fasli	Issued by the Department of Agriculture, Hyderabad-Deccan	Government Central Press, Hyderabad-Deccan
Annual Administration Report of the Department of Agriculture, Mysore for 1935-36. Price Rs. 1-8-0	Issued under the authority of the Department of Agriculture, Mysore	Department of Agriculture, Mysore, Bangalore
Soil Erosion	R. Madhavan Pillai .	Government Press, Travancore
Castor Cultivation. *Kast-i-Arandi*. Price As. 1	Dr. J. K. Dubey . .	Government Press, Bhopal
AGRICULTURAL STATISTICS		
Supply and Distribution of Various Types of Indian Cotton during the Season of 1935-36. Statistical Bulletin No. 6 (1935-36). Price As. 8	Issued by the Secretary, Indian Central Cotton Committee	Indian Central Cotton Committee, Bombay
Stocks of Indian Cotton held in India by the Mills and the Trade on 31st August 1937. Statistical Leaflet No. 2. (Fourth issue 1936-37). Price one anna	Ditto .	Ditto
Receipts at Mills in India of Raw Cotton classified by Varieties 1936-37 Season. Statistical Leaflet No. 3 (Fourth issue 1936-37). Price one anna	Ditto .	Ditto
Exports by sea of Indian Raw Cotton classified by Varieties 1936-37 Season. Statistical Leaflet No. 4 (Fourth issue, 1936-37). Price one anna	Ditto .	Ditto

Title	Author	Where published

AGRICULTURAL STATISTICS—*contd.*

Title	Author	Where published
Season and Crop Report of the Punjab for the year 1936-37	Issued by the Department of Agriculture, Punjab	Government Printing, Punjab, Lahore
Season and Crop Report, Sind, for 1936-37. (In press)	Issued by the Department of Agriculture, Sind	The Daily Gazette Press Ltd., Karachi

SUGAR RESEARCH

Title	Author	Where published
Cultivation of Sugarcane in Tanjore Delta. Leaflet No. 82 of the Department of Agriculture, Madras	M. Anandan . .	Government Press, Madras
The Open Pan System of White Sugar Manufacture in Factories Completely Installed with Machinery Designed by the Bengal Department of Agriculture. Bulletin No. 1 of 1937 of the Department of Agriculture, Bengal. *Gratis*	Issued by the Department of Agriculture, Bengal	Office of the Director of Agriculture, Bengal, Dacca
Improved Methods of Cane Cultivation in the United Provinces. Bulletin No. 72 of the Department of Agriculture, United Provinces. Price Re. 1-8-0	Rai Bahadur R. L. Sethi, and others	Superintendent, Printing and Stationery, United Provinces, Allahabad
General Information about the Sugarcane Crop in the United Provinces (Urdu and Hindi). Leaflet No. 37 of the Department of Agriculture, United Provinces. Free in U. P. only	Issued by the Department of Agriculture, United Provinces	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Western Circle, Aligarh 3. Deputy Director of Agriculture, Eastern Circle, Partabgarh 4. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur 5. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
Improved Methods of Cultivation and other Important Cultural Operations of Sugarcane (Urdu). Leaflet No. 38 of the Department of Agriculture, United Provinces. Free in U. P. only	Ditto	Ditto

SUGAR RESEARCH—*contd.*

Title	Author	Where published
Irrigation of Sugarcane Crop (Hindi and Urdu). Leaflet No. 39 of the Department of Agriculture, United Provinces. Free in U. P. only	Issued by the Department of Agriculture, United Provinces	1. Deputy Director of Agricelture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Western Circle, Aligarh 3. Deputy Director of Agriculture, Eastern Circle, Partabgarh 4. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur 5. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
Manuring of Sugarcane Crop in the United Provinces (Hindi and Urdu). Leaflet No. 40 of the Department of Agriculture, United Provinces. Free in U. P. only	Ditto .	Ditto
Ratooning of Sugarcane (Urdu). Leaflet No. 42 of the Department of Agriculture, United Provinces. Free in U. P. only	Ditto .	Ditto
Open Pan Boiling for *gur* and Sugar Manufacture (Urdu). Leaflet No. 43 of the Department of Agriculture, United Provinces. Free in U. P. only	Ditto .	Ditto
Manufacture of *Khandsari* Sugar as a Cottage Industry in Bihar (In press). Bulletin No. 2 of 1937 of the Department of Agriculture, Bihar	Issued by the Department of Agriculture, Bihar	Government Printing, Bihar, Gulzarbagh
Work Done on Sugarcane in Orissa (English). Bulletin No. 11 of 1937 of the Department of Agriculture, Orissa	Issued by the Director of Development, Orissa	Orissa Government Press, Cuttack
Sugarcane Cultivation and Sugar Industry	V. Narayanan Nair .	Government Press, Travancore

Title	Author	Where published
COTTON TECHNOLOGY		
Technological Reports on Trade Varieties of Indian Cottons, 1937. (Technological Bulletin Series A). Price Re. 1-8-0	Dr. Nazir Ahmad . .	Indian Central Cotton Committee, Vulcan House, Nicol Road, Ballard Estate, Fort, Bombay
Technological Reports on Standard Indian Cottons, 1937. (Technological Bulletin Series A). Price Re. 1-8-0	Ditto .	Ditto
The Effect of Different Degrees of Compression on the Fibre Properties and Spinning Quality of Indian Cottons. (Technological Bulletin Series A). Price As. 8	Ditto .	Ditto
Spinning Tests on Punjab-American 4F Cotton with Different Schemes of Drafts in the Speed Frames. (Technological Bulletin Series A). Price As. 8	Ditto .	Ditto
A Device for Determining the Proportion of Fibres of Different Lengths in a Sample of Cotton. (Technological Bulletin Series B). Price As. 8	Ditto .	Ditto
Studies in the Variation of Strength and Weight per Inch with Group Length of Cotton Fibres. (Technological Bulletin Series B). Price As. 8	Ditto .	Ditto
Spinning Test Report on Samples of Latur Cotton, 1936-37. (Technological Circular No. 882). Price As. 4	Ditto .	Ditto
Spinning Test Report on Samples of Bengal Cotton, 1937-38. (Technological Circular No. 912). Price As. 4	Ditto .	Ditto
Spinning Test Report on Samples of Moglai Cotton, 1937-38. (Technological Circular No. 913). Price As. 4	Ditto .	Ditto
Technological Report on Verum (Nagpur) 1937-38. (Technological Circular). Price As. 4	Ditto .	Ditto
FRUITS		
Prunning of Deciduous Fruit Trees (Hindi and Urdu) under print. Bulletin No. 18-F. S. of the Department of Agriculture, United Provinces	R. S. Singh . . .	Superintendent, Printing and Stationery, United Provinces, Allahabad

Title	Author	Where published
FRUITS—*contd.*		
"The Loquat" under print. Bulletin No. 19-F. S. of the Department of Agriculture, United Provinces	Pratap Singh . .	Superintendent, Printing and Stationery, United Provinces, Allahabad
Phalon ka bagh lagana. (Urdu). Leaflet No. 68 of the Department of Agriculture, United Provinces. Free in U. P. only	Issued by the Department of Agriculture, United Provinces	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Western Circle, Aligarh 3. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 4. Deputy Director of Agriculture, Eastern Circle Partabgarh 5. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
A Note on Peach Cultivation in Chota Nagpur. Leaflet No. 4 of 1937 of the Department of Agriculture, Bihar	Issued by the Department of Agriculture, Bihar	Government Printing, Bihar, Gulzarbagh
For the Attention of Banana Cultivators	V. Narayanan Nair .	Government Press, Travancore
LAC		
A Technical Process for Washing and Refining Stick Lac. Bulletin No. 27. Price As. 3	A. K. Thakur . .	Director, Indian Lac Research Institute, Namkum, Ranchi, Bihar
Preparation of Bleached (White) Lac. Technical Note No. 3. Price one anna	Issued by the Director, Indian Lac Research Institute, Namkum	Ditto
AGRICULTURAL SCIENCE		
GENERAL		
The Indian Journal of Agricultural Science, Vol. VII, Parts 4-6. Annual subscripion Rs. 15 or 24 *s*. (Original scientific work in the various branches of science applied to agriculture, formerly published in the Memoirs of the Imperial Department of Agriculture in India is now published in the *Indian Journal of Agricultural Science*)	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Civil Lines, Delhi

Title	Author	Where published

AGRICULTURAL SCIENCE—*contd.*

GENERAL—*contd.*

Title	Author	Where published
Scientific Reports of the Imperial Agricultural Research Institute, New Delhi (for the year ending 30th June 1937). Price Rs. 3	Issued by the Director, Imperial Agricultural Research Institute, New Delhi	Manager of Publications, Civil Lines, Delhi

BOTANY

Title	Author	Where published
Annual Report of Botanical Section, Bihar. Bulletin No. 8 of 1937 of the Department of Agriculture, Bihar. (In press)	Issued by the Department of Agriculture, Bihar	Government Printing, Bihar, Gulzarbagh
The Genetics of Gossypium and its Application to Cotton Breeding	J. B. Hutchinson, P. D. Gadkari and M. A. A. Ansari	Director, Institute of Plant Industry, Indore

CHEMISTRY AND PHYSICAL CHEMISTRY

Title	Author	Where published
Annual Report of Chemical Section, Bihar. (In press). Bulletin No. 7 of 1937 of the Department of Agriculture, Bihar	Issued by the Department of Agriculture, Bihar	Government Printing, Bihar, Gulzarbagh
Preservation of Cow-dung Manure (Oriya). Bulletin No. 7 of 1937 of the Department of Agriculture, Orissa	Issued by the Director of Development, Orissa	Orissa Government Press, Cuttack
Compost (English). Bulletin No. 9 of 1937 of the Department of Agriculture, Orissa	Ditto	Ditto
The Composition of Some Cattle Feeds of Burma. Bulletin No. 35 of the Department of Agriculture, Burma. Price As. 4	M. M. Menon	The Superintendent, Government Printing and Stationery, Burma, Rangoon
Khad (Manure). In Urdu and Hindi. Price As. 1	Dr. J. K. Dubey	Government Press, Bhopal
Night Soil. (Malayalam) (Leaflet). Free	Issued by the Department of Agriculture, Cochin	Director of Agriculture, Cochin, Trichur
Compost (Malayalam) (Leaflet). Free	Ditto	Ditto

ENTOMOLOGY

Title	Author	Where published
The Mango-hopper (Telugu, Tamil, Kanarese and Malayalam). Leaflet No. 77 of the Department of Agriculture, Madras	M. C. Cherian	Government Press, Madras

AGRICULTURAL SCIENCE—*contd.*

ENTOMOLOGY—*contd.*

Title	Author	Where published
Sugarcane Pests in the United Provinces (Under print). Bulletin No. 73 of the Department of Agriculture, United Provinces	B. D. Gupta . .	Superintendent, Printing and Stationery, United Provinces, Allahabad
Insect Diseases and their Remedies (Urdu). Leaflet No. 53 of the Department of Agriculture, United Provinces. Free U. P. only	Issued by the Department of Agriculture, United Provinces	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Western Circle, Aligarh 3. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 4. Deputy Director of Agriculture, Eastern Circle, Partabgarh 5. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
The White Fly of Cotton. Leaflet No. 141 of the Department of Agriculture, Punjab. Free	Issued by the Department of Agriculture, Punjab .	Superintendent, Government Printing, Punjab, Lahore
Surface Grass-hoppers '*Toka*'. Leaflet No. 142 of the Department of Agriculture, Punjab. Free	Ditto .	Ditto
An Easy Method of Destroying Cactus with Cochineal Insects (Marathi). Leaflet No. 14 of the Department of Agriculture, Central Provinces and Berar. Free	Issued by the Department of Agriculture, Central Provinces and Berar	Superintendent, Government Printing, Central Provinces and Berar, Nagpur
How to Control '*Tid*' (Urdu). Leaflet No. 2 of the Department of Agriculture, Baluchistan. Free	Issued by the Department of Agriculture, Baluchistan	Agricultural Officer in Baluchistan, Quetta
Codling Moth and its Control in Baluchistan (Urdu). Leaflet No. 3 of the Department of Agriculture, Baluchistan. Free	Ditto .	Ditto
The Spotted Boll-worm Pest of Cotton and how to Control It. (English and Urdu). *Gratis*	Issued by the Publicity Officer, Indian Central Cotton Committee	Indian Central Cotton Committee, Bombay

Title	Author	Where published

AGRICULTURAL SCIENCE—*contd.*

Plant Diseases

Title	Author	Where published
Sendomans Citre Disease of the Citrus (Urdu). Leaflet No. 63 of the Department of Agriculture, United Provinces. Free in U. P. only	Issued by the Department of Agriculture, United Provinces	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Western Circle, Aligarh 3. Dep ty Director of Agriculture, Bundelkhand Circle, Jhansi 4. Deputy Director of Agriculture, Eastern Circle, Partabgarh 5. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
Wither Tip and Die Back Disease of the Citrus (Urdu). Leaflet No. 64 of the Department of Agriculture, United Provinces. Free in U. P. only	Ditto .	
Leaf Minor Disease of the Citrus (Urdu). Leaflet No. 65 of the Department of Agriculture, United Provinces. Free in U. P. only	Ditto .	
Handbook of Plant Diseases of Economic Importance in the Central Provinces. Bulletin No. 28 of the Department of Agriculture, Central Provinces and Berar. Price As. 8	Issued by the Department of Agriculture, Central Provinces and Berar	Government Printing, Central Provinces and Berar, Nagpur
How to Control Bunt of Wheat (Urdu). Circular No. 1 of the Department of Agriculture Baluchistan. Free	Issued by the Department of Agriculture, Baluchistan	Agricultural Officer in Baluchistan, Quetta

VETERINARY SCIENCE AND ANIMAL HUSBANDRY

Title	Author	Where published
Agriculture and Live-stock in India, Vol. VII, Parts 5 and 6 and Vol. VIII Part 1. Annual subscription Rs. 6 or 9 *s.* 9 *d.* (A bi-monthly journal of agriculture and animal husbandry for the general reader interested in agriculture or live-stock in India or the Tropics)	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Civil Lines, Delhi
The Indian Journal of Veteri ary Science and Animal Husbandry, Vol. VII, Parts 3 and 4. Annual subscription Rs. 6 or 9 *s.* 9 *d.* (A quarterly journal for the publication of scientific matter relating to health, nutrition and breeding of live- tock	Ditto .	Ditto
Agriculture and Animal Husbandry in India, 1935-36. Price Rs. 4-10-0 or 7 *s.* 9 *d.*)	Ditto . .	Ditto

VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*

Title	Author	Where published
Investigations on the Course and Distribution of the Nerves supplying Levator anguli scapuli and Rhomboideus muscles and Formation of th Phrenic Nerve in the Ox with Observations on certain Anatomical Deviations. Scientific Monograph No. 11 of the Imperial Council of Agricultural Research, 1937. Price Rs. 4-10-0 or 7 *s.* 9 *d.*	H. N. Chelva Ayyangar	Manager of Publications, Civil Lines, Delhi
Selected Clinical Articles, Part II. Miscellaneous Bulletin No. 15 of the Imperial Council of Agricultural Research. Price Re. 1-4-0 or 2 *s.*	G. K. Sharma, R. L. Kaura, S. Ganapathy Iyer, G. S. Khan and M. Y. Maugrulkar	Ditto
Indian Grazing Conditions and the Mineral Contents of Some Indian Fodders. Miscellaneos Bulletin No. 16 of the Imperial Council of Agricultural Research. Price Rs. 3-14-0 or 6 *s.* 9 *d.*	P. E. Lander . .	Ditto
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The United Provinces Veterinary Magazine (English and Urdu). Monthly. Issued free to members of the United Provinces Veterinary Association	Issued by the United Provinces Veterinary Association	Editor, *United Provinces Veterinary Magazine*, Moradabad
The Punjab Veterinary Journal . .	Issued by the Punjab Veterinary Association	The Editor *The Punjab Veterinary Journal*, Lahore
The Central Provinces Veterinary Journal. Quarterly .	Issued by the Central Provinces Veterinary Association	The Honorary Secretary, Central Provinces Veterinary Association, Nagpur
Feed your Bullock (English) (Reprinted). Broad Hint No. 1 of the Department of Agriculture, Madras	G. R. Hilson .	Government Press, Madras

VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*

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VETERINARY SCIENCE AND ANIMAL HUSBANDRY—*contd.*

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Agriculture & Live-stock in India

Vol. VIII, Part IV, July 1938

EDITORIAL

INTERNATIONAL SCIENTIFIC CONGRESSES AND CONFERENCES

INTERNATIONAL Congresses and Conferences of all sorts and dealing with all kinds of subjects, are a feature of modern life. Science is responsible for a good many of these meetings and agricultural science has its full share of them. Several conferences or congresses of agricultural interest now meet at fixed intervals of three or five years, at different places and in different countries, thus giving an opportunity for visiting scientists to see new territory and to examine, on the spot, crops, cultivation methods and field experiments, which, to be understood, must be studied on their own ground and in their own climate. Last year there was held in England the Fourth International Grassland Congress and in Berlin the Eleventh World Dairy Congress, at both of which India was represented. In the current year there will be held in Berlin the Twelfth International Horticultural Congress and the Seventh International Entomological Congress.

Another International Congress of great interest to agricultural scientists is the Seventh International Congress of Genetics, which will take place in Edinburgh in 1939 and for which the preliminary notices have already been sent out. This will be held from 23rd to 30th August 1939. The Secretary is Professor F. A. E. Crew, well known throughout the world, whose closer acquaintance was made by many scientists in India during his recent visit to the Jubilee Session of the Indian Science Congress in Calcutta.

It is hoped shortly to publish in this journal as complete a list as possible of International Congresses and Conferences of agricultural interest likely to be held during the next five years.

Delegates to International Congresses have both to give and to receive. The French Colonial Minister—M. Marius Moutet—speaking at the inauguration of a series of Colonial Congresses in Paris on the 20th September 1937, remarked on the influx of ideas of all kinds, from all quarters, which characterise such a congress and likened it to a cross-roads where many problems meet.

It is astonishing how much that is taken for granted by an agricultural scientist working in one country is new to a worker in another country. This is particularly true when the one worker is in a temperate zone, the other in the tropics. Nothing should therefore be regarded as commonplace, for the simplest recorded practice or observation may give rise to a train of thoughts or discussion which may lead to important results in the understanding of natural processes or in the improvement of commercial or field practices. Such, for example, was the excellent discussion on the indigenous plough, which took place at the meeting of the Crops and Soils Wing of the Board of Agriculture in November, 1937. Again, despite the steady improvement of abstract journals and similar facilities, for maintaining contact between scientific workers in different countries, it is still not unusual to find that isolated workers are incompletely informed of the advances made elsewhere and employ out-of-date methods or even unwittingly repeat a laborious investigation.

In a world in which, for good or for evil, we are all now becoming so very much nearer to one another, it is the more essential that we shall understand one another fully, and understanding is based on knowledge. We may therefore confidently expect International Congresses and Conferences in the future to play an even greater part than in the past, in the increase of knowledge, in the advancement of science and in the development of greater understanding between peoples.

The Late Mr. I. F QUIRKE, M.R.C.V.S. I.V.S.

OBITUARY

T. F. QUIRKE, M.R.C.V.S., I.V.S.

The entire veterinary profession in India have learnt, with deep regret and profound sorrow, of the sad and untimely death from pneumonia of Mr. Thomas Francis Quirke, M.R.C.V.S., I.V.S., Director of Veterinary Services, Punjab, which occurred at the Albert Victor Hospital, Lahore, after a brief illness on Thursday, January 13th, 1938.

Born on June 6th, 1891, at Tipperary, Ireland, the deceased, after a preliminary education at the Clongowes Wood College, Sallins, from 1905 to 1909, joined the Royal Veterinary College, Ballsbridge, Dublin, and received his Diploma of M.R.C.V.S. in 1913. Soon after qualifying as a veterinary surgeon, he was engaged in private practice with Mr. Hamilton, M.R.C.V.S., at Ballina, for about a year before being appointed to the veterinary staff of the Irish Department of Agriculture and Technical Instruction. Mr. Quirke came out to India in February, 1915, having been appointed to the Indian Civil Veterinary Department, now known as the Indian Veterinary Service. He served for some six years as a Superintendent in this Department at Ferozepur and Rawalpindi. In June, 1921, he was promoted to the post of Chief Superintendent in succession to the late Lieut.-Colonel Farmer, and to that of Director of the Civil Veterinary Department in July, 1928. In 1929, when the Veterinary Department was separated from the Agricultural Department, he was appointed (in November) Director of Veterinary Services in the Punjab, and continued to hold this post until his death. He had thus been at the helm of veterinary affairs in the Punjab province for nearly eighteen years. As the Punjab Government appreciation stated, 'During this period the Veterinary Department of the Province has attained a growth and a fame unparalleled in India, and a large share of this success was due to Mr. Quirke's unstinted efforts, wide knowledge and unfailing enthusiasm.' The statistics given below show the progress made by the Department under the control

The Late Mr. T. F. QUIRKE, M.R.C.V.S., I.V.S.

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of Mr. Quirke from the time he assumed charge as Chief Superintendent in 1920 to the time of his death :—

	1919-20	1937-38
No. of Veterinary Hospitals in Punjab . . .	137	304
No. of Outlying Dispensaries	..	1,200
No. of Stud bulls	1,352	5,370
No. of Cattle Fairs and Shows held . . .	35	252
Strength of Non-gazetted Staff employed in District Work	192	393
Strength of Gazetted Staff employed . . .	15	36

In the death of Mr. Quirke in the prime of his life, when only a little over 46 years of age, the veterinary profession in India has lost an outstanding member of long experience, great personality and forcefulness at a time when he was most needed. Having specialised in the peculiar problems of India appertaining to the control of contagious diseases of animals, improvement of indigenous breeds of live-stock and general animal husbandry matters, he best understood the difficulties of the profession, and was always out to lend a helping hand and give valuable advice to both officials and private persons. The magnitude of his loss to the country as a whole, and to the Punjab in particular, will be realised by those who knew him and who had the privilege of working with and under him. His diligent dutifulness, soundness of judgment, unassuming nature, simplicity of habits and outspoken criticism coupled with real kindliness and general sympathetic behaviour will long be remembered by all with whom he came in contact, either in his official capacity as the head of the Veterinary Department in the Punjab, or as a private individual. As an administrator he commanded respect and his opinion in technical matters was greatly valued.

" Tom," as Mr. Quirke was affectionately called by his many personal friends, was a well-known and popular figure in Lahore society and was closely connected with the Lahore Race Club, where, for a number of years, he assisted as a veterinary officer and as a time-keeper. His memory will ever remain in the hearts and minds of the people of the Punjab Province for whose sake he was always engaged in hard and enduring work. [A. C. A.] [Reprinted from the *Veterinary Record*, 12th February, 1938.]

Col. SIR ARTHUR OLVER. C.B., C.M.G., F.R.C.V.S.

ORIGINAL ARTICLES

COLONEL SIR ARTHUR OLVER, C.B., C.M.G., F.R.C.V.S.

An Appreciation

For the last eight years Colonel Sir Arthur Olver's name has been synonymous with animal husbandry development in India. As is well known, the Royal Commission on Agriculture in India left, as its most enduring result, the Imperial Council of Agricultural Research. Sir Arthur Olver was appointed as the first Animal Husbandry Expert of this body in 1930. Sir Arthur Olver had previously had a brilliant and varied career in the Royal Army Veterinary Corps. He served in the South African War and, while attached to the Army Headquarters at Pretoria, was given special opportunities to pursue his already strongly marked bent for veterinary research under Sir Arnold Theiler. Later he was posted to the Egyptian Army as its Principal Veterinary Officer and with this new appointment there also went that of Principal Veterinary Officer of the Sudan Government. For that Government he carried out very successful campaigns against rinderpest, which was then rapidly approaching through Abyssinia in the direction of Egypt. During the Great War, Sir Arthur Olver served with the Army in France and during a mission to the United States of America did a particularly striking and useful piece of work in finding out and combating the cause of very high mortality in horses and mules shipped from the United States of America and from Canada to Europe.

Sir Arthur Olver's appointment gave a definite impetus to veterinary education and research and live-stock improvement. During his eight years in India, he has constantly had before him the idea of adequate development of agriculture on the animal husbandry side and for that purpose has applied both his scientific knowledge and his skill in organisation to the building up of both the research and development sides of live-stock industry. As a result of this energy may be mentioned the following tangible results :—

(1) the new Animal Nutrition and Poultry Research Sections at the Imperial Veterinary Research Institute, Izatnagar, where also there will be the All-India Veterinary College.

(2) the Disease Investigation Officers now in every province and certain States who are specially devoted to the study of animal diseases in

Col. SIR ARTHUR OLVER, C.B., C.M.G., F.R.C.V.S

(Matzene Studio)

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the field and who, while under control from the Centre, are of the utmost help to the Provincial Departments.

(3) the many breeding, nutrition and dairying schemes which are now financed by the Imperial Council of Agricultural Research, etc.

(4) the greatly improved status of the whole of the live-stock industry side of both the Central and the Provincial Agricultural Departments.

The first All-India Cattle Show held at New Delhi in February of this year was an astonishing demonstration of the nature and variety of India's cattle wealth and will long remain in the memory of all those who saw it. The organisation of this was in Sir Arthur's hands. His most recent publication, *viz.*, the brochure entitled " A Brief Survey of some of Important Breeds of Cattle in India " with its collection of very striking photographs of Indian cattle, is still another noteworthy achievement of the Animal Husbandry Expert who has now retired. These are some concrete examples of Sir Arthur Olver's initiation but, as is often the case, the intangible results of his eight years' work are more important. His insight and wide knowledge of animal breeding and management have been of inestimable value to those with whom he has worked. His influence has steadily aroused an interest in Veterinary Research which was previously lacking. Sir Arthur Olver is the possessor of many well-deserved honours. The Knighthood conferred on him in 1937 was a recognition of his services to India which gave great pleasure to all those with whom he had come into contact but especially to the many officers in the agriculture and veterinary services with whom he had collaborated. His many friends in India wish him the full enjoyment of his well earned retirement.

The Koer cultivator of Bihar

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

XI. THE BIHAR CULTIVATOR

BY

D. R. SETHI, M.A., B.Sc. (Edin.), I.A S

Director of Agriculture, Bihar

Bihar is predominantly an agricultural province. With a total population of some thirty-two millions and a total cultivated area of twenty-four million acres the pressure on land is heavy. In parts of the province where agricultural conditions are favourable the intensity of population per square mile is as high as 960.

The province has three natural agricultural divisions. The river Ganges divides Bihar proper into two parts. The area lying to the north of this river and extending up to the foot-hills of Nepal is known as North Bihar. Here the predominant soil type is light alluvium, soil moisture is high and moisture holding capacity of the soil very good. There is a great diversity of crops in this area and almost all crops including sugarcane are grown without artificial irrigation. It is rare to find a field without a crop during the major part of the year. The pressure on land in this part of the province is great.

The area south of the river Ganges is known as South Bihar. Here the predominant soil type is clay and the main crops are rice, sugarcane and *rabi* cereals and pulses. Irrigation is a necessity to ensure reasonable outturns.

The third natural agricultural division of the province is the area comprising the Chota Nagpur plateau. The predominant population in this area is aboriginal and agriculture is not intensive ; the main crop being rice which depends upon the monsoon for a successful harvest.

Eighty per cent of the people depend directly on agriculture. In Bihar proper almost all communities and castes are agriculturists, and standards of cultivation vary considerably. Amongst all the cultivating classes in Bihar the most advanced are the Koeris or Kushwaha Kashatriyas. Simple in habits, thrifty to a degree and a master in the art of market gardening the Koer is amongst the best of the tillers of the soil to be found anywhere in India.

During his childhood the Koer indulges in the usual village pastimes and games—chiefly *kabadi*. From his boyhood onwards his one passion is cultivation and he usually devotes his whole time to his work in the field. Because of his thrifty habits he usually manages to keep clear of debts. In years of bountiful harvests he invests all his savings in either making additions to his holding or in improving his holding by providing himself with adequate irrigation facilities or a good pair of bullocks.

He knows the value of good seed, conserves his manurial resources, looks after his work-cattle and goes in for intensive cultivation. He rarely hires labour but makes all his family members including his women-folk work in the fields. The result is that in a good year he is better off than his neighbours while in a lean year he usually manages to make two ends meet.

The Koer does not indulge in any expensive social ceremonies and spends very much less on marriages than other cultivating classes. He is religious and as a rule avoids intoxicants.

When there is less pressure of work he takes great pleasure in reciting verses from religious books and joins in musical gatherings of a religious nature.

Such in brief is the life of this hard-working, intelligent and industrious son of the soil.

FIG. 1. Sind *hari* starting for work

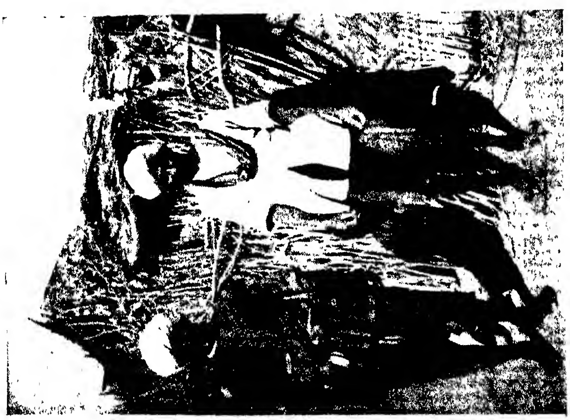


FIG. 2. Sind *hari* ready for reaping

FIG. 3. Sind *hari* going out to cart

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

XII. THE SIND CULTIVATOR

BY

W. J. JENKINS, M.A., B.Sc. (Edin.)

Director of Agriculture, Bombay Presidency

The Sindhi *hari* or cultivator is essentially the "backbone" of Sind and, to all who have worked with and among his communities, a man worthy of admiration and respect. On account of the constant stream of immigrants into Sind from the north, the inroads of Cutchis and Marwaris from the east, and the contact with Arab invaders from the west, the cultivator population of Sind is a mixture of races in which Baluchis, Brohis, Marwaris, Cutchis, Pathans and Arabs predominate. In the north, the average *hari* is tall, robust and well-built, with a broad intelligent face, large dark eyes and a wheat-coloured complexion. Many of them wear beards and permit their hair to grow long and, in general, are impressive and striking types of mankind. In Middle Sind, the physical appearance of the *hari* is not so striking and in South Sind, this deterioration in size and impressiveness is still more marked. Similarly, as physical size decreases from north to south of the province, energy and activity also decline and the southern peoples are in general more indolent and ease-loving. However, the *haris* of Sind, taken as a whole, compare very favourably in physical characteristics and in manliness with their brothers in other parts of India. In general, the Sind *hari* is trustworthy, dependable and honest. Fond of his home and family, he works hard to support them and he is chivalrous and kind towards his womenfolk. His hospitality is proverbial and, in many cases, this trait in his character is responsible to a large degree for his pecuniary difficulties. He is intensely religious and the *pirs* or priests with which Sind abounds exercise an enormous influence over their followers in the cultivating communities. The *hari* is not as a rule superstitious but holds certain beliefs which retard his progress and which are most difficult to eradicate. For instance, it is still widely believed that the sprinkling of sand, over which the *pir* has read some incantation, over a crop will drive away white ants and that an amulet obtained from the same religious mentor will prevent the onset of disease or cure the physical illness of its wearer.

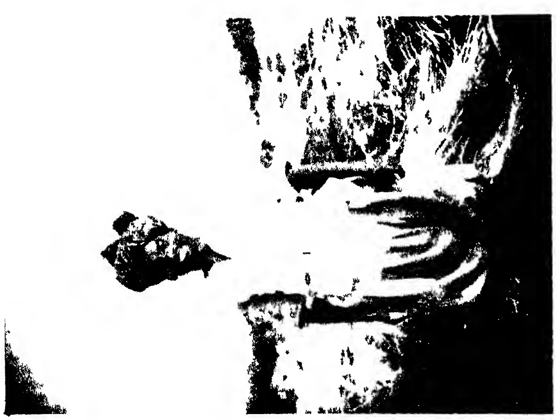
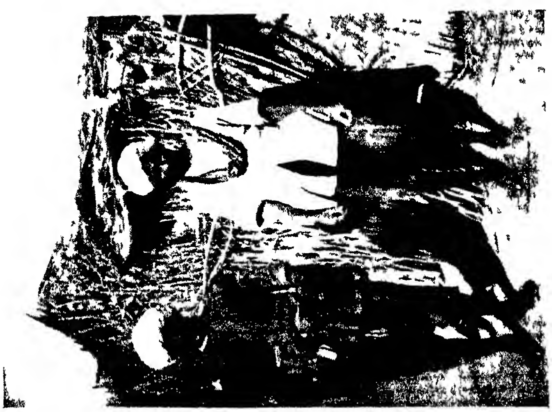


FIG 1 Sind *hari* starting for work



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As an agriculturist, the Sindhi *hari* is hard-working and does not spare himself in the cultivation of his holding. However, he is almost invariably a tenant-at-will of some zamindar or land-owner, whose lands he cultivates on the *batai* or share system. This system of land tenure leads to lack of interest in permanent improvement of the fields and to lethargic and fatalistic outlook in the face of difficulties and crop failures. It may be said that, in Sind as in other parts of the world, a good landlord makes good tenants and few land proprietors could have more useful and valuable tenants, if treated properly and fairly, than the zamindars of Sind. The Sindhi *hari* is no more conservative than farmers all the world over and he is intelligent and quick to take up improvements if it can be proved to him that they will be of advantage to him in his cultivation.

The great majority of the Sindhi *haris* profess Islam as their religion and have a common type of dress usually worn by Muslims all over Sind. A large turban or *pattiko*, made of coarse cloth, is worn with or without a small cap. A small shirt or bodice, called *sadri* or *phati*, generally white or indigo dyed, covers his body from neck to waist while his lower limbs are encased in voluminous, baggy, trousers known as *shilwar* or *suthan*. The poorer classes of cultivators wear the *kainch* or trousers of similar shape but inferior material. The shoe of the *hari*, called *ghetlo*, is a peculiar and uncomfortable looking foot-wear which is generally carried in the hand during long journeys and only put on within village limits. Made of heavy, village-cured leather, such shoes will last several years and are useful weapons in self defence or in village and tribal encounters. A coarse *chaddar* or sheet of homespun cloth, often dyed in different colours, and thrown over the shoulders or head, completes a picturesque but serviceable outfit.

The Sindhi *hari* is, in general, a great sportsman and his favourite pastime is attendance at local wrestling matches or *malakhras* in which he often participates. These matches are common features of the numerous religious fairs which are held all over Sind. Competitions are arranged between the champions of different localities and raise considerable enthusiasm among the crowds of supporters. No *malakhra* is complete without the attendance of a band of drums and pipes which stimulate both the competitors and the audience. The successful wrestlers at a *malakhra* receive cash prizes contributed by the local well-to-do *haris* and zamindars.

A different but no less popular recreation of the Sindhi cultivator is singing and attendance at musical renderings of local folk-songs and ballads. Such ballads generally deal with love episodes and religious sophisms, composed by the famous Sindhi poets of the past. Of these, Shah Abdul Latif of Bhitshah, a village in Middle Sind, who lived about two hundred years ago, is pre-eminent for his saintliness and art. His name is a household word among the Sindhi *haris*. The single wire instrument used for accompanying such musical recitals is known as the

yaktaro but pipes of different types such as the *been* or *ner* are common at village gatherings when the leisure hours are spent in story-telling and song.

On holidays and fairs the sporting instincts of the *haris* become evident in the organization of races of bullock carts, ponies or camels. Any one who has had the pleasure of attending the famous Horse Show at Jacobabad can testify to the excitement and enthusiasm which such contests evoke among the cultivators who travel incredible distances to witness them.

These are various indoor and outdoor games which the *hari* and his family indulge in as a mode of recreation. Cock-fighting is a common pastime in some parts of Sind and hunting with dogs or falcons helps to relieve the monotony of village life. The advent of perennial irrigation under the Barrage is likely to limit very severely the time available for such pursuits and recreations but the ingrained love of sport in the Sindhi *hari* will persist even under conditions of more intensive agricultural practice.

The Sindhi *hari* is not without his vices. He is generally a spendthrift and improvident and, in common with his brethern in other parts of India, is often deeply in debt to the village money-lenders. He is a true Muslim in his outlook upon strong drink but is a confirmed tobacco smoker and the *hukka* or 'hubble-bubble' is his constant companion even in the field. He is a great admirer of the opposite sex and when his admiration outruns his discretion, crimes and blood feuds become common in the district. Owing to the comparative shortage of females in Sind, such occasions are not infrequent.

With regard to his mode of living, the Sindhi cultivator likes comfort and his conditions impose upon him simplicity. His house is generally walled with mud or *od* and is thatched with reeds and branches. In the fields, he resides in a small hut or *landhi* made of plastered reeds and thatched with straw, a similar shelter being prepared close by for his cattle. In the centre of his hut, there is a square fire-place on which the housewife cooks the food and which keeps the inhabitants warm in winter. The *hari* and his family dislike sleeping on the ground and, in the hot summer season in particular, his bed is made up on raised platforms or *pehies*. In winter, a carpet made of rag patches known as *rillies* is used as a mattress. In the villages, the *haris'* huts are closely congested and built in clusters as a defensive precaution against thieves and dacoits. His furniture consists of a mat and *sandle* or wooden seat and a few simple utensils of brass and earthenware for cooking and storing his food.

The *haris'* food consists, as a rule of three meals a day. *Neran* or breakfast, prepared early, is of *jowar* or *bajri* bread, which may be lightly buttered and a bowl of *lassi* or buttermilk. *Manjhand* or lunch is generally taken at home and consists of pulse (*dal*) or vegetable. At times of special festivity or on holidays a chicken may be added. *Lassi* is also drunk with lunch. In the evening, dinner consists of bread and vegetable with a little milk. Meat is added to the diet

about three or four times a month and generally on occasions when the villages can share in the consumption of a goat, sheep or calf. At times of festival and ceremony, a rice *pulau* of beef, mutton or chicken is provided for the feast together with sweetmeats and *gul*. The Sindhi *hari* is fond of butter and ghee, which he adds to his diet whenever it can be procured.

The Sindhi cultivator is an early riser and is punctilious about his personal cleanliness and appearance. Whenever he takes food, he washes his hands and face thoroughly before eating and rinses out his mouth after the repast is over. He invariably utters the name of God (*Bismillah*) as a grace before meals. In addition to keeping his body clean, the *hari* is proud of his hirsute adornments and uses unguents and oils in his personal toilet.

It would not be possible to conclude this brief pen picture of the Sind *hari* without some reference to the changing conditions of his life under perennial irrigation from the Lloyd Barrage. In pre-Barrage days, the complete dependence of the Sind cultivator on the vagaries of the river Indus and its inundation season, gave rise to a fatalistic attitude towards life which has erroneously been interpreted as inertia and laziness. It was not long after the perennial water supply entered the great canals of Sind that the Sindhi cultivator began to adapt himself to the new conditions. Farming lands which do not belong to him, oppressed by poverty and debt and, in many cases, working for unsympathetic *kamdars* appointed by absentee landlords, the Sindhi *hari* has shown already that he is prepared to play his part in the development of his native land. All who have known Sind and its cultivators can testify to the worthiness and manliness of its "sons of the soil" and must wish them a greater degree of prosperity and comfort in the years to come.

TICK FEVER IN DOMESTICATED ANIMALS IN INDIA*.

BY

HARENDRA NATH RAY, M.Sc., Ph.D. (Lond.)

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From time immemorial mankind has been intimately associated with animals, and their utility to the human race, both as a means of transport and a source of food, was realised long before histories came to be written. Pestilential calamities that befell cattle and horses were treated empirically as were those of their owners. With the gradual development of knowledge of the various ailments of men and animals, empiricism gave way to a more accurate and systematic appreciation of the prevailing diseases. Science has provided man with ways and means of probing into the mysteries of creation and of discovering the cause of various important diseases affecting man and animal. One of the most important gifts of Science to mankind is the microscope, which aids in the better diagnosis of certain diseases, thereby enabling alleviation of suffering to be effected. For instance, the group of diseases known as tick fever in domesticated animals—with which we are concerned in this article—was known long before its causal organisms were discovered with the help of the microscope. When the causal organism of a disease was seen, another equally important problem that emerged was the determination of the manner in which a disease is disseminated from animal to animal under natural conditions. After sauntering through various avenues of scientific investigations, earlier workers have equipped us with the important information that there is yet another group of organisms, zoologically belonging to the phylum Arthropoda, which unknowingly transmit the disease from one animal to another on account of their blood-sucking habits. These are either ticks or insects.

Tick fever in live-stock is produced by micro-organisms which belong to the group of animals, zoologically placed under the phylum Protozoa. To define a protozoan is a difficult task but for practical purposes it is sufficient to know that it consists of a speck of living substance, the protoplasm, with a single regulating vital centre, the nucleus. It is due to this apparently simple organisation that the name "protozoa", which means "primitive animal", was applied to this

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* This is the tenth of a series of popular articles for practical farmers on various animal husbandry subjects of general interest.

group of organisms. Tick fever in animals is produced chiefly by the protozoa commonly known as piroplasms and hence "piroplasmosis" is another term employed for this affection. In addition to piroplasmosis there are certain other diseases, *viz.*—anaplosmosis, spirochaetosis—which are transmitted through the agency of ticks. So we can well realise the vagueness of the term "tick fever" and therefore now-a-days, to be precise, the disease is designated after the particular parasite with which the animal is infected.

In this article the writer has endeavoured to narrate the stories of disease-producing protozoa which are transmitted to our domestic animals through the agency of ticks.

As the protozoa primarily affect the blood of their hosts, a few words about the structure of blood will not be out of place here. Blood is composed of two elements, the liquid portion is called plasma or liquor sanguinis while the other is the cellular or corpuscular part which remains suspended in this liquid medium. Of the cellular elements we can make out three distinct types of cell, *viz.*, (1) red-blood corpuscle or erythrocyte (devoid of nucleus in mammals) containing the red-colouring substance or hæmoglobin in it. These cells have the property of combining with the atmospheric oxygen while circulating through the respiratory organs, the lungs, and carrying this important life-maintaining gaseous element to every part of the body and in turn absorbing the waste gaseous product, carbon dioxide, which is eliminated through the lungs. The number of these cells per cubic millimeter of blood remains constant in an average healthy animal as shown by the following figures :—

Horse—7·8 millions per cubic millimeter

Ox—6·7 to 8·8 millions per cubic millimeter

Dog—6·1 millions per cubic millimeter

(2) White-blood corpuscle or leucocyte—possesses a nucleus, whose nature varies in different types of leucocytes ; these cells have the power of engulfing and destroying any foreign invader in the body, and defend the body from any foreign attack. Their number too, per cubic millimeter of blood, is constant in an average healthy animal ; (3) blood platelets—these are minute bodies which remain scattered throughout the blood system and usually appear in clusters of more than two. The function of these bodies, as far as it is known, is to prevent the coagulation of blood.

In order to have a first-hand knowledge of blood parasites, it is necessary to adopt the following technique by which the organisms are rendered readily visible under the microscope. Prick the extremity of the ear of an affected animal (except in birds where usually a small wing vein is punctured) with a finely pointed needle and as soon as the blood flows, lightly place a clean glass slide on it, so that a small quantity of blood adheres to the slide. Before the

drop is dry, spread it evenly with the help of the edge of another slide. The film so made dries almost immediately. Now place a few drops of methyl alcohol (acetone-free) on the film and allow this reagent to act on it for about a minute. Flick off the alcohol and flood the slide with dilute Giemsa stain (prepared by adding one and half drop of stock Giemsa solution to 1 c.c. of neutral distilled water). This stain is allowed to act on the film for twenty minutes, after which the film is washed in running tap water for some time until a metallic lustre is visible on the film when seen against the light. The film is now ready for examination under the microscope. However, it requires considerable experience to make good blood-films and stain them satisfactorily by means of the method outlined above. It is therefore advisible to obtain assistance of trained men in matters like this and have the blood smears examined in the nearest laboratory.

Figures given at the end of the article are self-explanatory and show the common protozoan parasites of the blood known to be transmitted through the agency of ticks.

All domestic animals are liable to infestation with various species of ticks and the fact that the number of hosts and the diversity of parasites with which each host may become affected makes the subject the more interesting. When an animal becomes infected with a pathogenic or disease-producing protozoan and survives the attack, it is usually not cleansed of the infection but carries the parasite in its system in a subdued state of existence, often throughout the remainder of its life. Such animals are said to be the "reservoirs" or "carriers" of the disease and on this account in countries where the necessary transmitting agents—vectors—are available, the particular disease is comparatively easily disseminated. In their initial stages of development most of the ticks are very small. They hide in such inaccessible parts of the body of the animal that they can only with difficulty be seen by a casual observer.

Tick fever in bovines.—The most common tick-borne disease occurring practically throughout this country is "Red-water fever" (Hæmoglobinuria), characterised by the red-coloured or blood-stained urine that is commonly—though not constantly—passed by such cases. This disease in India is caused by the introduction of a piroplasm called *Babesia bigemina* (Plate XXIV, Fig. 1) into the blood of cattle presumably by ticks named *Boophilus australis*. (Plate XXIV, Fig. 2). The vector—the tick—being common throughout India, the disease "Red-water" is relatively widespread and practically all indigenous cattle acquire infection in the early period of their lives. Having acquired a natural resistance against the disease at a tender age, usually no untoward symptoms are manifested and the piroplasms establish themselves in the system of the host without causing apparent harm at that time.

Later, however, a considerable loss in condition occurs in tick-infested animal on account of a constant absorption of sustenance by the ticks, and also due to harbouring the disease-producing protozoa in a dormant state. In cows an

appreciable depreciation in milk-yield may result on account of this. The critical stage arises when such "carrier" animals are invaded by any other febrile disease notably Rinderpest, or when their vitality is lowered through some other cause. The otherwise latent piroplasms then suddenly flare up and produce alarming complications. Clinical cases of acute and severe piroplasmosis, as a primary affection, occur in cattle which are imported from territories that are free from this disease, and also in indigenous cattle that may have escaped the infection in their early life. The disease can also be produced artificially by the inoculation of infected blood into susceptible bovines. This piroplasm, *B. bigemina*, as mentioned above invades the red blood cells where propagation takes place by a process known as budding. It has a characteristic pear-shaped appearance and occurs inside the red blood cells in pairs, joined or in contact with each other at their pointed ends. Individual parasites of various shapes, however, are also met with in cases when active process of multiplication is going on. The body of the parasite is seen to be largely composed of a blue staining cytoplasm, while the red-stained nucleus is seen to be situated towards the pointed end of the pear shaped organism. The infected red blood cells, however, are ultimately destroyed.

Symptoms.—The disease manifests itself with a sharp rise in temperature up to 105°F. or more. The animal becomes lethargic, remains aloof from the herd and seeks shady places. The appetite becomes depraved while thirst is increased; rumination is suspended, muffle is dry and hot to the touch. The coat on the back is staring and the bowels constipated. After two to three days (depending upon the severity of infection) the urine is observed to be high coloured and in certain instances presents the characteristic port wine colour. This is due to the excretion of the colouring matter (hæmoglobin) of the destroyed red blood corpuscles through the kidneys. The visible mucous membranes appear pale, and general wasting due to anæmia occurs. If timely treatment is resorted to, the animal usually recovers from the malaise.

Diagnosis.—The most reliable method of diagnosis is by the examination of blood smears. A couple of smears should be made according to the method outlined above and sent to the nearest laboratory for examination.

Treatment and control.—The discovery of a synthetic drug Trypanblue, by Nuttall and Hadwen in 1909 as a curative agent for infection with *B. bigemina* in cattle has been a boon to the veterinary profession. This drug has been extensively employed all over the world as a remedy for Red-water with success. It is administered in a one per cent solution, preferably intravenously, at a dose of 100 to 200 c.c. according to the size and weight of the animal. After intravenous injectior of the drug all the mucous membranes become blue, the temperature abates within twenty-four to forty-eight hours while most of the parasites are destroyed. In some cases more than one injection of the drug may be necessary to get the desired effect. Careful nursing along with easily digestible and

nourishing diet is most helpful in restoring the animal to a normal state of health. Recently another proprietory drug, Acaprin, has been found to be very effective in cleansing the system of the *bigemina* parasites. The administration of this drug is simple as compared to that described above. One cubic centimeter per 100 lb. body-weight injected subcutaneously has been found to be sufficient to effect a complete cure.

To save our live-stock from drastic consequences and to safeguard against considerable economic loss due to tick-borne diseases, prevention is evidently the wiser course to adopt. From the knowledge of the life-history of these arthropods, a vigorous campaign against complete eradication of ticks is a very desirable procedure. In the Southern parts of the United States of America control measures have been adopted at enormous expense and a remarkable success has been achieved. Efforts in this direction must be uniform and well planned before the desired result can be obtained. The tick concerned in causing bovine Red-water—*Boophilus australis*—is known to be a continuous feeder, *i.e.*, after attaching itself to the skin of its host as larva it passes through the remaining stages of its development on the host and finally drops off as a full grown adult. As a larva it feeds for four to six days and then moves to an adjacent place to moult. After moulting it becomes a nymph and feeds for six to eight days in this stage ; then moults and becomes an adult and drops off when fully grown. The female lays eggs on the grass and under suitable conditions the eggs hatch out in about three weeks to over two months (depending upon the temperature) producing innumerable larvae. The uncultivated pasture lands therefore serve as a source of great danger to the cattle population. Obviously it is essential that the pastures should be frequently changed and cultivated or ploughed. These blood-sucking arthropods can also be dealt with while they are on the body of the animal. Various cattle-dipping tanks have been designed which are filled with some chemical solution through which herds of cattle are passed at regular intervals (three to five days). The solution contains some arsenical preparation which is highly deleterious to the ticks. The dipping solution commonly used are :—

(1) Arsenic	8¼ pounds
Caustic soda	4 pounds
Stockholm tar	1 gallon
Water	400 gallons

The arsenic and soda are boiled in water first and then added to the remainder of the solution.

(2) Soda arsenate	1 pound
Soft soap	¾ pound
Paraffin	2 pounds
Water	100 gallons

The tank should be about thirty-five feet long and contain about 2,500 to 3,000 gallons of dip. If dipping of cattle is practised regularly infestation with ticks is considerably minimized. In some places chemical sprays have been used on affected cattle but dipping tanks appear to be more effective than sprays.

Other intracellular blood parasites.—Another protozoan parasite with which cattle in India are perhaps ubiquituously infected is *Theileria mutans* (Plate XXIV, Fig. 3). This is a comparatively small parasite also inhabiting the red blood cells of the host. *Theileria mutans* as it occurs in this country has not been observed to cause any ill effects in " carrier " animals even when the vitality of these animals is lowered due to some intercurrent febrile diseases or to some other cause. Recently another Theileria parasite, *Theileria annulata,* has been recognised to cause an appreciable mortality amongst cattle in India, specially in imported animals. The disease caused by this organism has also been recorded from hill cattle at Mukteswar where it has been found to run a very acute and frequently fatal course. Theileria parasites are much smaller than *B. bigemina* measuring about one micron[1] in diameter. The parasites show a multiplicity of forms, namely, round, oval, and rod or comma-shaped. In *T. annulata* (Plate XXIV, Fig. 4a) the round or ring forms are predominant, *i.e.*, about eighty per cent being round forms while in *T. mutans* the ratio of ring to other forms may be about forty-five to fifty-five per cent. The body of the parasite contains very little cytoplasm and is chiefly composed of a ring of cytoplasm with the nucleus situated at the border. Propagation or multiplication in *T. annulata* takes place by means of a process called schizogony in the cytoplasm of the large mononuclear leucocytes of the internal organ, chiefly lymphatic glands, spleen and liver. Such multiplying forms or schizonts are often called Koch's bodies (Plate XXIV, Fig. 4b). Koch's bodies are invariably encountered in the peripheral circulation in infection due to *T. annulata.* Blood from infected cattle showing Koch's bodies is easily inoculable into susceptible bovines. In infection due to *T. mutans* Koch's bodies are very rarely seen. Propagation in this species chiefly occurs by a process of division of the parasite into two or four daughter individuals inside the red blood cell. It is presumed that infection in cattle due to Theileria parasites is brought about by the bites of infected ticks [probably *Hyalomma aegyptium* (Plate XXIV, Fig. 8) in India].

Symptoms.—As mentioned above infections due to *T. mutans* do not produce any ill effects. The symptoms are therefore of but little value when compared with cases due to *T. annulata.*

The disease due to *Theileria annulata* as observed among imported and as well as hill cattle under natural conditions is usually of a very acute type. The mortality is very heavy, being sixty to seventy per cent or more. The incubation period on artificial inoculation ranges between fourteen to twenty-one days, and the first symptom of the disease is the rise of temperature to 104-106°F.

[1] One micron (μ) is eqivalent to 1/1000 of a millimeter.

The parasite may not be demonstrated in the peripheral blood for four or five days after the onset of fever. Lachrymation and flow of saliva are almost constant symptoms. In the beginning constipation is observed which, as the disease progresses, may lead to diarrhœa with passage of blood. A very characteristic and a predominant symptom is that of enlargement of the superficial lymphatic glands, *viz.*, the prescapular and the precrural. In view of the fact that the lymphatic glands comprise one of the predilection seats of multiplication of the parasite, a very reliable means of diagnostic confirmation of the disease is afforded by the microscopical examination of the fluid extracted by puncturing one of these glands with a hypodermic needle. The liver and spleen become considerably enlarged in Theileriasis. Ecchymosis is present in almost all the internal organs. The kidneys become highly congested and in several cases infarcts are observed on the surface. Hæmoglobinuria is absent in spite of a heavy destruction of the red blood cells. From the onset of fever the course of the disease in acute cases does not usually exceed a week or ten days. The affected animals refuse all kinds of food and have to be hand-fed with milk, gruel and other nourishing diet

Treatment.—Drug treatment of acute Theileriasis in cattle has so far baffled veterinary workers and none of the various drugs so far tried have proved to be of any marked value. Usually 30 c.c. of one per cent solution of Plasmoquin is administered intravenously, but Atebrin has been found to give best results in experimental Theileriasis. Stress, however, must be laid on good nursing, stimulants and the administration of such agents as are likely to maintain the vitality of sick animals.

Anaplasmosis.—Anaplasma are minute spherical structures that occur in the red blood corpuscles of cattle and, perhaps in many other domestic animals. Opinions vary widely in regard to the true nature of these structures. Two different species namely, *A. marginale* (Plate XXIV, Fig. 5) and *A. centrale* have been recorded from cattle, but in India the former only has so far been recognised. It measures from 0·1 to 0·5μ in diameter. Infected red cells containing more than one parasite are not infrequently met with in heavily infected cases.

Anaplasmosis as a distinct disease entity is on record from all parts of the world. In popular terms it is known as "gall sickness" owing to symptoms of jaundice associated with fever that are observed in this condition. Affected cases show mucus discharge from nostrils, lachrymation, and constipation followed by diarrhœa. No hæmoglobinuria, as in Red-water, is present but the urine is of deep yellow colour. Usually very severe anæmia results and the mortality in acute cases is fairly high.

Treatment.—Sodium cacodylate, an arsenic preparation, has been tried with successful results. Repeated injections of 80 grains dissolved in four ounces of normal saline solution given intramuscularly are necessary to overcome the ill effects of the disease.

Tick-borne diseases of sheep and goats.—Three different species of *Babesia* in all probability communicated through the agency of ticks, are known to cause disease in sheep and goats. These are *B. motasi*, *B. sergenti* and *B. ovis*. Besides these there is a species of *Theileria*, namely, *T. ovis* also reported from our country. All these parasites mentioned above infect the red blood corpuscles of their hosts. It must be admitted, however, that very little attention has so far been paid to the study of the disease caused by these parasites in this country. With the exception of a few records of scattered clinical cases no further observations are available.

Babesia motasi (Plate XXIV, Fig. 13).—This is the largest of the piroplasms that invade the red cells of sheep and goats and give rise to symptoms and lesions indentical to those caused by *B. bigemina* in cattle. Morphologically also it bears a close resemblance to *B. bigemina*. It occurs in pairs and measures about $2 \cdot 5$—4μ in dimensions. Hæmoglobinuria is a characteristic symptom of this disease.

Babesia ovis (Plate XXIV, Fig. 14).—This parasite is smaller than *B. motasi*, measuring about 1—$2 \cdot 5\mu$ in length. Although double pear-shaped forms are sometimes met with in blood smears, this parasite usually occurs singly and has a tendency to occupy a marginal position in the red cell. The round forms are, however, the most common. The acute phase due to the infection with this parasite is manifested by fever, jaundice, and progressive anæmia.

B. sergenti (Plate XXIV, Fig. 15).—This is the smallest of the *Babesia* recorded from sheep and goats. Rounded and bacillary forms occur in the red cells. Division takes place by means of budding.

Excepting *B. motasi*, which is transmitted through the tick *Rhipicephalus bursa*, no precise information regarding the tick involved in the transmission of other *Babesia* is available. The tick *R. bursa*, however, has not so far been found to occur in India.

Theileria ovis (Plate XXIV, Fig. 16).—In a "carrier" condition this parasite is not infrequently met with in the blood of sheep and goats. No evidence of disease due to Theileria infection in these animals is recorded from this country. Transmitting agent is not known as yet.

Anaplasma marginale (Plate XXIV, Fig. 17).—This parasite bears the same relation to the infected red cells of sheep and goats as it does in cattle. No symptoms of any disease are, however, indicated in sheep and goats. "Carrier" animals may show it in the blood due to some other intercurrent disease. Nothing is known about its transmitting agent.

Tick-borne diseases in horses.—In the horse two species of *Babesia* are known to be transmitted by the agency of ticks. These are *B. caballi* (Plate XXIV,

Fig. 6) and *B. equi* (Plate XXIV, Fig. 7) (often called *Nuttalia equi*). The former is the bigger of the two and resembles morphologically *B. bigemina* of cattle. It occurs in the red blood cells of the host in the characteristic double pear-shaped forms and divides by a process of budding. As a result of infection high fever followed by hæmoglobinuria is not infrequently met with in acute cases.

Treatment.—Trypanblue is the drug of choice for infection due to *B. caballi.* An intravenous injection of 100 to 200 c.c. of one per cent freshly made solution is recommended.

B. equi.– Perhaps in India equine piroplasmosis is more commonly due to *B. equi* infection than the previous species. This, as mentioned above, is the smaller of the two parasites and occurs singly in the red blood cells of the host. Division takes place by budding and four newly-formed daughter individuals are often seen to arrange themselves in a manner which gives the group the characteristic appearance of a Maltese cross (Plate XXIV, Fig. 7)

Jaundice is a characteristic symptom ascribed to this infection. Hæmoglobinuria is absent. Very high fever rising up to 106°F. or more has been observed in the imported animals. The particular tick which carries these infections in India is, however, not known, but *Hyalomma aegyptium* has often been suspected to infest equines in this country.

Treatment.—Very successful results have been achieved by the administration of quinine hydrobromide in *B. equi* infections. The dose is one grm. dissolved in water given intravenously and sometimes more than one injection may be necessary to combat this infection. In some cases the administration of this drug has caused some alarm owing to a depressant action, but the untoward symptoms can easily be overcome by the injection of a suitable dose of strychnine hydrochloride.

Tick fever in dogs.—Perhaps no other disease of dogs is so widespread in India as tick fever. Imported dogs are more severely affected than those bred locally, but nevertheless quite a large number of the latter succumb to tick fever. Those which survive are usually adult dogs that had probably become infected as puppies and thereby developed a tolerance to the disease.

With most of the Hunts in India, and dog fanciers, who own imported dogs, tick fever is, undoubtedly, an indomitable pest.

One attack of the disease does not always confer an immunity and a dog that once becomes infected and passes through tick fever, is liable to relapse. Furthermore, there is evidence which points to the conclusion that the virulence of the causative agent varies in those parts of the country where the disease is endemic. So that those dogs that may have successfully survived an attack

in one part of the country may become severely affected when taken to another part, and die. Two species of *Babesia*, namely, *Babesia canis* and *B. gibsoni* are recognised in India. They invade the red blood corpuscles of dogs and give rise to the disease popularly known as tick fever. Although *B. canis* was first discovered in the blood of dogs in 1895 by Piana and Gallivalerio in Lombardy, it was not until 1915 that Webb and Christophers showed this parasite to occur in India also. *B. gibsoni* was first seen by Patton in 1910 in the blood of the dogs of the Madras Hunt and in the jackal. Now, however, it is believed that tick fever in dogs in India is perhaps most commonly due to *B. gibsoni* infection. Mixed infection due to both the species is also met with.

B. canis (Plate XXIV, Fig. 9) is a large parasite occurring in the double pear-shaped forms identical to *B. bigemina* of cattle. Individual parasites of various shapes, *viz.*, round, oval, amœboid, are also met with in cases where active multiplication by a process of budding is going on.

The dissemination of *B. canis* has been proved to take place by the bite of the common dog-tick *Rhipicephalus sanguineus* (Plate XXIV, Fig. 10). But in the case of *B. gibsoni* in addition to the tick just mentioned there is another vector which is called *Haemaphysalis bispinosa* (Plate XXIV, Fig. 12). Both the ticks belong to the class of "dropping-off ticks" and apart from imparting infection in their larval, nymphal, and adult stages, it has been recently demonstrated by Shortt that hereditary transmission of *B. canis* takes place through the eggs of *R. sanguineus.*

Babesia gibsoni (Plate XXIV, Fig. 11) morphologically simulates the Theileria parasite of cattle. Its usual shape is that of a small ring. Occasionally bigger parasites of various shapes and sizes are also seen in smears made from heavily infected cases. The parasite measures 0·5 to 2 μ in diameter. The nucleus is represented by a dot usually placed at the border of the ring. In heavily infected cases the red blood cells may be crowded with parasites but usually only one or two parasites occur in a cell.

Symptoms.—Dullness, inappetence, and dryness of the nose are the premonitory signs. The temperature gradually rises to 103°F. and may at times reach 106°F. The coat appears to be rough and staring and the breath has a foul odour. Constipation is invariably present which is subsequently followed by diarrhœa. The urine at this stage is of high colour.

In cases of *B. canis* infection hæmoglobinuria may be observed. The mucous membrane of the mouth and eyes appear pale and gradual wasting takes place. Sometimes the cornea may become opaque. The blood becomes thin due to the destruction of the red cells. The liver and the spleen are considerably enlarged. The mucous membrane of the internal organs are seen to be stained with bile pigment. When the disease is prolonged for some time a complication such as

pneumonia usually supervenes and kills the dog. The temperature drops after four or five days to 100 or 101°F. to rise again within a short while. When the disease is well advanced, food is totally refused.

Treatment.—Several drugs have been tried by various workers with good results. These are :—

Trypanblue, Acaprin, Novarsenobillon, Sulfarsenol and Tryparsamide.

Trypanblue.—This is an aniline dye and is a very successful agent in regard to *B. canis* infection. The dose is 1 c.c. of a 1 per cent solution in normal saline solution given intravenously per every 5 lb. body-weight of the animal. If fever continues the dose may be repeated after an interval of five to six days. This drug has no effect on *gibsoni* infection.

Acaprin.—This drug is a recent introduction in the domain of treatment of canine piroplasmosis and has been reported to be highly efficacious for *B. canis* infection. The dose is 1-2 c.c. of 1 per cent solution introduced subcutaneously. This drug too has failed to act on *gibsoni* infected cases.

Novarsenobillon.—This is an arsenical preparation and is administered intravenously. For a dog weighing 40 lbs., 0·45 grms. of the drug is dissolved in 5 to 10 c.c. of distilled water and given by the intravenous route. For smaller animals the dose is reduced proportionately. This drug is very successful in combating *canis* infection, and has proved of use in *gibsoni* infection also.

Sulfarsenol.—This also is an arsenical compound and is as efficacious as the previous drug with an additional advantage that it can be administered subcutaneously. The dose for a dog weighing 40 lbs. is 42 centigrammes dissolved in 20 c.c. of distilled water. It can be obtained in sealed ampoules of various doses.

Tryparsamide.—It is an arsenical compound and has been preferred by some workers for cases infected with *B. gibsoni*. It can be given either subcutaneously or intravenously. The following doses, according to the size of the animal, are to be dissolved in 5-10 c.c. of distilled water :—

0·42 grms. for small dogs.

0·85 grms. for medium size dogs.

1·7 grms. for hounds.

Five to eight injections given at an interval of five days may be necessary to affect a cure.

In addition to the drug treatment, good nursing and proper hygienic surroundings are necessary. Fresh water and clean bedding should always be provided for the sick dog under treatment. Nourishing food, such as eggs, soup, milk and chopped liver are necessary to preserve the vitality of ailing animals. Occa-

sionally a dose of Epsom salts should be given to keep the bowels clean. When the disease has been overcome a course of good tonic should be given.

Control.—Where a pack of hounds is maintained for sporting purposes it is essential to house the animals in tick-proof kennels. The building should contain a minimum of wood work as the ticks hide in the crevices. It should be surrounded by a moat four inches in width and three inches in depth in which a solution of phenyle or other agent is maintained. Another moat about half way up the inside wall is also preferable as the ticks have a tendency to climb to the ceiling from where it is difficult to dislodge them. The inside of the kennels should be frequently washed with disinfectants or burnt with a blow lamp. Before the dogs are introduced into such kennels an endeavour should be made to de-tick them as far as possible. In badly infested dogs a dressing with kerosine oil emulsion followed by a hot bath should be practised as this procedure will render them tick-free. Dipping has also been practised in some places with successful results.

Tick fever in poultry (Spirochaetosis).—Thread like spiral organisms found in the blood of poultry have been shown to be transmitted by the tick, *Argas persicus.* Tick fever or spirochaetosis in poultry is of wide spread occurrence in this country and causes enormous loss in fowls. Ducks, geese, turkeys and canaries are, however, susceptible to this disease when infected blood is introduced into them. Pigeons are as a rule resistant to infection. The tick *Argas persicus* (Plate XXIV, Fig. 19) when once infected with the spirochaete transmits the infection to its progeny through the medium of its eggs. A fowl not only gets infected by the bite of an infected tick but infection can also be brought about by the ingestion of these ticks by the bird.

Treponema anserina (Plate XXIV, Fig. 18) (also known as *Spirochaeta gallinarum*) the causal agent, is a thin cork-screw like organism and is found to wriggle about freely in the affected blood. It measures about 20μ in length and 0·5 to 1·5 μ in breadth. Multiplication takes place by fission or breaking up of a single thread like organism into two or more such organisms.

Symptoms.—The onset of the disease may be so sudden and acute as to cause death of the affected birds within twenty-four hours before any symptoms have been exhibited. In the less acute form there is dullness, ruffling of feathers, and diarrhœa, the stool often being of a greenish colour. The comb becomes pale owing to anæmia. The temperature reaches 110°F. to 112°F. and has a tendency to drop suddenly. In the chronic type that may follow the acute phase, paralytic symptoms are observed. The wings drop and the neck is twisted towards one side. The legs are also involved and the affected bird is noticed to crouch or lie down. Great emaciation usually follows a severe attack. The spleen and liver are greatly enlarged and the blood becomes thin and dark.

Treatment.—Arsenical preparations, *viz.*, Soamin and Atoxyl have proved to be very reliable drugs in the treatment of fowl spirochætosis. Of a 1 per cent solution 1-2 c.c. (or more, according to the weight of the body of the bird) is injected subcutaneously or intramuscularly. Two or three injections are sufficient to cleanse the circulating blood of the organisms. These drugs can also be used in a prophylactic manner.

Prevention.—This consists in ridding the fowl houses and birds of ticks. Dressings with petroleum or turpentine for the birds are effective in de-ticking them. The roosts and the nest should be burnt with a blow lamp. Kerosine emulsion, lime and creosote are advocated as sprays for the fowl houses.

The above account is but a very small part of the various types of diseases with which the live-stock of our country usually suffer. With our increasing knowledge about the behaviour of the causative organism and the transmitting agent we are now in a position to diagnose most of the protozoal diseases at an early stage and treat the malady. Still we have not reached a stage where we can cry ' halt ' to our investigations into the various untrodden avenues of implicate problems which have direct bearing to the well being of our live-stock. In order to improve the general health of our domestic animals, which, it must be admitted, is far from satisfactory, it is essential that our live-stock owners even in the interiormost villages of the country became thoroughly conscious of the problems that confront them, and established a close contact with the Disease Investigation Officers of their respective provinces.

It must be remembered that it is only by well considered and properly planned methods that remedial measures yield the desired beneficial effect.

EXPLANATION OF PLATE

PLATE XXIV

Fig. 1. *Babesia bigemina.*—Intracorpuscular parasites of cattle producing "Red-water fever". Note the paired arrangement of the pear-shaped organism.

Fig. 2. *Boophilus australis.*—Vector of above.

Fig. 3. *Theileria mutans.*—Common blood parasite of cattle. Note one ring and other rod-form parasite inside the same red blood cell.

Figs. 4-*a*, *b*. *Theileria annulata.*—Two forms of the parasite commonly met with in the blood of cattle suffering from acute Theileriasis. 4-*a*—ring form. 4-*b*—showing the parasite multiplying inside a large mono-nuclear white blood corpuscle. This is known as Koch's body.

Fig. 5. *Anaplasma marginale.*—A blood parasite which is not infrequently met with in cattle. It is known to produce jaundice accompanied by fever.

Figs. 6, 7. *Babesia caballi.* and *B. equi.*—Blood parasites of equines. *Babesia caballi* produces fever and sometimes hæmoglobinuria while infection with *B. equi* is characterised by very high fever and jaundice. In Fig. 7 note the ring form and the dividing form simulating Maltese cross.

Fig. 8. *Hyalomma aegyptium.*—Suspected vector of equine species of Babesia and Theileria parasites of cattle.

Fig. 9. *Babesia canis.*—Blood parasite of dog—known to produce hæmoglobinuria and jaundice. Four pear-shaped organisms seen within one red blood cell.

Fig. 10. *Rhipicephalus sanguineus.*—Vector of above.

Fig. 11. *Babesia gibsoni.*—Another blood parasite of dog—known to produce anæmia and high fever. Note three parasites of different shapes inside the same red blood cell.

Fig. 12. *Hæmaphysalis bispinosa.*—Vector which has recently been shown to transmit the above parasite.

Figs. 13-17. *Ovine piroplasms.*—

Fig. 13. *B. motasi.*—Largest of the piroplasms of sheep and goat. Known to produce hæmoglobinuria.

Fig. 14. *B. ovis.*—Presence of this parasite in the blood produces fever, jaundice and progressive anæmia in acute cases.

Fig. 15. *B. sergenti.*—This is the smallest of Babesia recorded from sheep and goat.

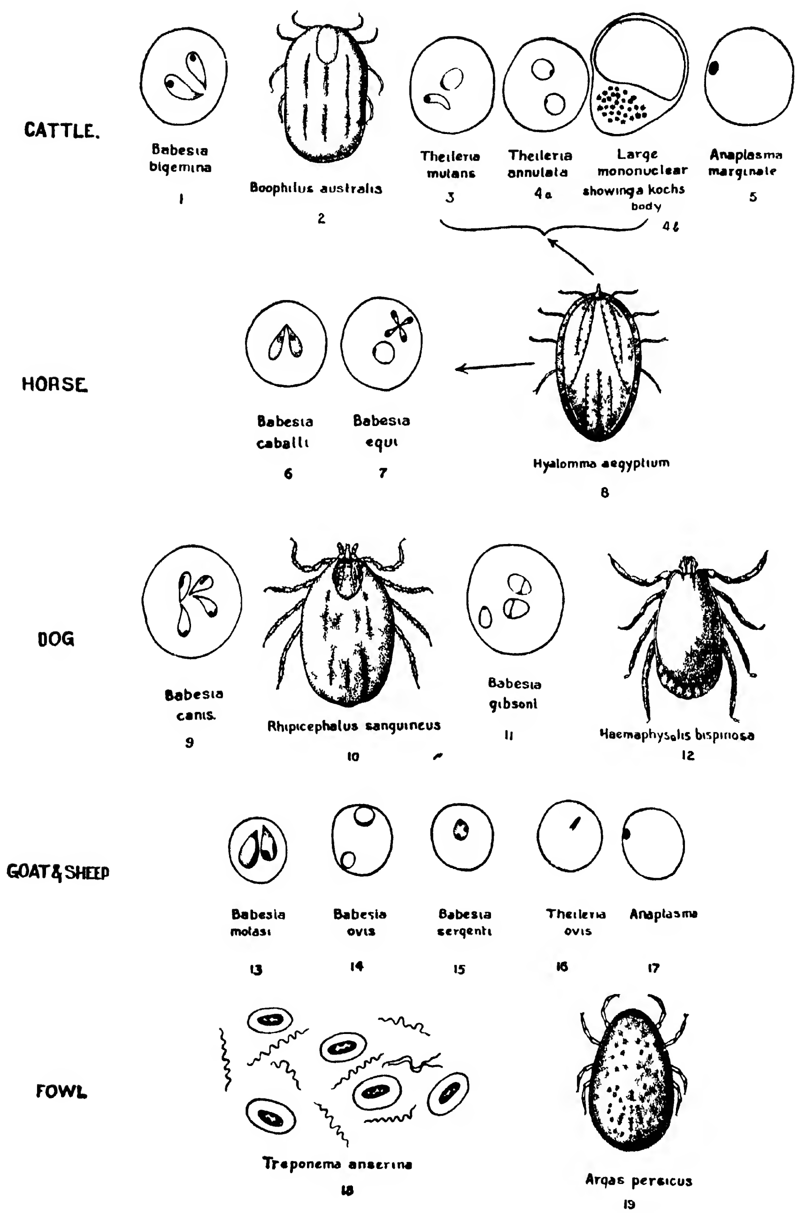
Fig. 16. *Theileria ovis.*—This blood parasite is not infrequently met with in sheep and goats of our country.

Fig. 17. *Anaplasma.*—Blood parasite resembling *A. marginale* of cattle. No symptom of any disease is however indicated in sheep and goats.

Fig. 18. *Treponema anserina.*—Causative agent of tick fever in fowls. Organisms are shown as spiral threads. The oval nucleated structures are the red blood corpuscles of the bird. This organism unlike those mentioned above is extracellular in habit.

Fig. 19. *Argas persicus.*—Vector of above.

PLATE XXIV


CATTLE.
Babesia bigemina
1
Boophilus australis
2
Theileria mutans
3
Theileria annulata
4a
Large mononuclear showing a kochs body
4b
Anaplasma marginale
5
HORSE
Babesia caballi
6
Babesia equi
7
Hyalomma aegyptium
8
DOG
Babesia canis.
9
Rhipicephalus sanguineus
10
Babesia gibsoni
11
Haemaphysalis bispinosa
12
GOAT & SHEEP
Babesia motasi
13
Babesia ovis
14
Babesia sergenti
15
Theileria ovis
16
Anaplasma
17
FOWL
Treponema anserina
18
Argas persicus
19

THE VALUE OF *AUS* PADDY STRAW AS A FODDER

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THE *Aus* paddy crop is a highland crop sown about the middle of March to May and harvested about mid-June to mid-November. It is the earlier rice crop, the name originating from the Sanskrit word "Ashu" meaning early or quick. Its normal acreage in the Presidency of Bengal is over six million (6,053,500) acres, the total paddy area being nearly 23 million acres, *i.e.*, more than a quarter (26·42 per cent) is under this crop. Of this area (under *Aus*) nearly fifteen per cent is in the Nadia District and ten per cent in the Mymensingh District. In most other districts the area is much limited, ranging from one to five per cent, whilst the lowest areas are in Darjeeling (0·06 per cent), Howrah (0·15 per cent), Hooghly (0·32 per cent) and Chittagong Hill Tract (0·94 per cent).

It will be obvious, however, that occupying as it does more than 26 per cent of the total paddy area in the province, its place as a source of fodder is not such as could be looked upon with neglect. Yet popular opinion about this fodder is very curious and even conflicting. In some localities it is considered as a good fodder, in others there is an impression that it reduces the yield of milk. Its harvest period falling often during the height of monsoon no doubt offers great difficulties in the way of proper drying and storage. This might affect the quality to a great extent.

At the same time it should be remembered that, unlike *Aman* paddy, this crop is harvested before it is dead ripe. One of the essential factors during the process of ripening is the transfer of nutrients from the straw to the grain. But being harvested somewhat earlier, some of the nutrients are likely to be held up in the straw. The analysis and digestion experiment with this straw also show that it holds definite superiority over *Aman* or winter straw. In fact, its position is something like oat straw in Great Britain, which on account of identical reasons (of being harvested before it is dead ripe) is found to be a more valuable fodder than wheat straw or barley straw.

The analysis of *Aus* straw shows that it is much richer in protein (5·88 per cent), oil (1·71 per cent), and lime (0·64 per cent), as compared to *Aman* straw. It is also definitely richer in other minerals such as magnesia, potash and phosphate. One of the chief criterions of a feed is its protein content and in this respect it appears to be superior to other kinds of paddy straw so far tested in India. It seems to be even better than American and European varieties.

It should be stated here that, although composition is a rough indication of the nature of feed, its real value depends on its nutritive effect which can only be ascertained by conducting careful tests. The nutrition section at the Dacca Farm started under the grant of Imperial Council of Agricultural Research recently conducted feeding and digestion tests with this straw and the results point to definite superiority of this fodder over that of *Aman*.

The primary requisites for the continuance and proper functioning of life are that (1) there should be reasonable supply of protein material for body-building and repair of waste, (2) sufficient energy from food to maintain body-heat and enable the system to function properly during rest, growth, work, milk production, etc., and (3) mineral matters so vitally necessary for the frame work of the whole body and maintaining proper reaction of the blood. The presence of vitamin is no doubt necessary and while this is generally deficient in dried straws, this straw is more likely to contain some, since it is harvested at a time when it is still partially or slightly green.

The protein in digestible condition must form certain minimum proportion of the total digestible nutrients. This proportion under Bengal requirement is probably about 1 : 16. In the case of European animals, which are brought up under a much higher plane of nutrition, this proportion is much higher, being about 1 : 8 to 1 : 12. If the proportion is very low the animal in its struggle for life has to draw the amount from the reserve of its own body, with the result that it loses condition, and when it loses condition it fails to make the proper utilization of the other nutritive constituents, even though they may otherwise be quite sufficient. Thus, in so far as energy value is concerned, the difference between *Aman* straw and *Aus* straw is practically negligible, yet because *Aus* straw contains on one side more protein (both in total and digestible form) and on the other better supply of lime and phosphorus, it helps in the process of digestion and thus throws out a larger amount of net energy and total digestible nutrients weight for weight, thereby offering a definite advantage over *Aman* straw. This can be best illustrated in the following table where the results have been computed per hundred lbs. of dry straw both for *Aman* and *Aus* ; and at the same time it has been also shown how in the case of *Aman* a small supplement of concentrate (as cake) makes for better economy.

TABLE I

Feeds	Dry matter	Digestible protein	Total digestible nutrients	Energy as starch equivalent	Nutritive ratio	When *Aman* is 100	
						T. D N.	S. E.
Aman straw when given alone .	100 0	--0 47	37·05	24·396	?	100·0	100·0
Aus straw when given alone .	100 0	+1·77	43·02	28 761	1 : 23	116·11	117·892
Aman straw when given with Cake.	100 0	+0·387	44·11	29·519	1 : 113	119 06	120·999

These results show two striking facts—one that when fed singly *Aus* straw provides about sixteen per cent more total digestible nutrients and about equal quantity more energy than *Aman* straw under the same condition and that this is chiefly due to a better availability of protein and mineral nutrients than in *Aman* straw; secondly, a small addition of concentrate (as in the case of *Aman* straw) contributes more towards real economy by throwing open much larger amount of total digestible nutrients and energy supply.

At this stage another highly important factor has to be stated. *Aus* straw, although definitely richer in digestible protein and mineral than *Aman* straw, does not still contain as much as is necessary for proper maintenance. So a small dose of concentrate helps in various ways. Its protein content being higher, a smaller dose of concentrate will be enough to give an approximately equivalent result which in the case of *Aman* paddy will require more. In other words, *Aus* straw is economical in two or three ways—one because it is initially richer than *Aman* straw in protein and minerals and, secondly, because of this initial advantage it requires as a supplement only a very small quantity of concentrate, and thirdly, the small supplement of cake is followed by an increased consumption so that the mineral side is largely satisfied.

It should not be forgotten that *Aus* and *Aman* straws are only roughages and it is rarely the case that a roughage by itself is a complete and well-balanced feed. A small dose of concentrate is always a necessity and is to the ultimate advantage.

This can be best judged from the following experiments with *Aus* straw. Here nine animals were divided into three lots ; (1) one lot was given only *Aus* straw, (2) the second lot was given a supplement of half lb. of linseed cake with straw and the (3) third lot ¾ lb. of cake plus straw. The straw was given *ad lib.*, *i.e.*, as much as they could eat. All the animals were given requisite amounts

of salt and water. Their daily live-weights were recorded. The experiment lasted for forty-one days. Unfortunately the supply of straw was not sufficient to continue the feeding longer. To ascertain the amounts digested, the collection of feed faeces, urine, etc., was conducted for ten consecutive nights and days and the average per day was worked out from the figures.

As live-weight is one of the main indications of the nutritive effect of a feed, it is shown as follows :—

TABLE II

Group	Period of feeding	Animal No.	Average live-weight At start	At end	Loss or gain in live-weight
					Lb.
Aus straw only . . .	..	D_1	487·9	488·2	+0·3
	41 days	D_3	533·4	525·2	—28·2
		D_7	481·9	459·6	—22·3
Aus straw and ½ lb. cake .	41 days	D_2	517·6	527·6	+10·3
		D_8	440·5	451·0	+10·5
		D_9	591·3	599·2	+7·9
Aus straw and ¾ lb. cake .	41 days	D_4	529·0	547·6	+18·6
		D_5	468·5	480·0	+11·5
		D_6	550·4	552·0	+1·6

It will be noted from this that during the course of forty-one days, two out of three animals under "*Aus* straw only" lost about two stones in their live-weights. One of the animals D_1 remained stationary. This is most likely due to better individual efficiency of this animal but a longer period of feeding might possibly have reflected in a loss of its live-weight also. The addition of half a lb. of linseed definitely contributed towards an increase of their live-weights. With ¾ lb. cake, two animals have shown greater increase, but one, *viz.* D_6, has remained almost stationary. This again might be due partly to lower individual efficiency of this animal as opposed to higher efficiency noted in the case of D_1 and partly to its heavier weight. Evidently, this animal (D_6) probably needed a still larger dose of cake. The results generally are however convincing and show how a small supplement of cake is indispensable for proper utilisation of roughage.

In fact, its benefit is reflected in better consumption, *i.e.*, better appetite, larger availability of total digestible nutrients and in greater thriftiness. This will be illustrated from the average values as shown under the following table.

TABLE III

Nutrients per day from straw computed per 1,000-lb. live-weight

	Consumption from straw		When straw is 100	
	Dry matter	Total digestible nutrients	Dry matter	Total digestible nutrients
	Grm.	Lb.	Grm.	Lb.
Aus straw only	12·184	5·259	100·00	100·00
Aus straw and ½ lb. cake .	15·315	6·513	125·655	124·534
Aus straw and ¾ lb. cake .	15·601	6·148	128·003	117·016

For a proper comparison all the values here have been converted on the basis of 1000-lb. live-weights. It will be seen that the addition of cake has increased the appetite, (*i.e.*, consumption) to 25·66 per cent with ½ lb. cake and 28·00 per cent with ¾ lb. cake. The total digestible nutrients also exhibit still increasing percentages. The somewhat low average of ¾ lb. is due to low individual efficiency of an animal D_6.

It is necessary to add here that under the condition of feeding in Bengal not only is there a deficiency in protein supply but there is an equally poorer supply of mineral. In the case of rice straw feeds the lime supply mainly comes from the share of straw, but experiments at Dacca have shown that the lime from straw is not as readily assimilable as probably from other feeds, and on this account a comparatively larger quantity (about twenty-four grms. per 500-lb. live-weight) is required. The supply of phosphorus from straw is also very low and this can be supplemented by cake which will also make up the protein deficiency. It has been found that the addition of about half a lb. linseed cake has supplied the protein and phosphorus needs on one side and by increasing the consumption of straw has helped in a positive lime balance.

It should be the aim of every intelligent cattle owner that not only does his animal receive requisite supply but that under the existing shortage of supply every possible attempt should be made of the most economic utilization of the limited resources that the country is able to provide at present.

In this investigation the behaviour of *Aus* straw on milk-yield could not be included as the supply of straw was much limited. Its general richness in vital constituents is definitely more in its favour than with *Aman* straw, but pending trial it would be advisable that while feeding milch cows the behaviour should be carefully watched. The most deciding factor appears to be associated with the quality of the straw, and if it is stored badly and becomes mouldy it is bound to be deleterious in effect.

The investigation on *Aus* straw so far shows that

(1) Weight for weight it is a better fodder than *Aman* straw.

(2) It is richer in protein and minerals and hence requires lesser amount of concentrate than *Aman* straw.

(3) It is harvested when it is slightly green and hence is likely to be better provided in vitamins.

(4) It occcupies more than one fourth of total paddy area of Bengal, and every attempt should be made to conserve and store this valuable fodder properly and carefully.

PRELIMINARY NOTE ON THE BEHAVIOUR OF RICE *KURA* (BRAN) AS A CATTLE FEED

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THE estimated outturn of different kinds of paddy in Bengal is about 280 million maunds or over ten million tons. It is not exactly known how much of it constitutes rice bran and how much rice polish. Fraps [1916], however, carried out a comprehensive investigation in U. S. A. and he found that the average yield of products and by-products per bag of 162 lbs. paddy was as follows :—

TABLE I

Variety	Per 162 lb.			Per cent*		
	Hulls	Bran	Polish	Hulls	Bran	Polish
Japan . .	29	14	5	17·90	8·64	3.09
Honduras .	34	15	5	20·99	9·26	3.09
Blue rose .	29	13	4	17·90	8·02	2·47

It will be noted from this table that bran and polish together constitute about ten to twelve per cent of paddy. On a similar basis if we assume 8·5 per cent as bran and three per cent as polish, the by-products available from rice manufacture in Bengal would work out at 23·8 million maunds bran and 8·4 million maunds as rice polish, giving a cattle food to the tune of over thirty-two million maunds. In a country so poorly supplied with concentrates for cattle, the value of such a large amount of an important by-product cannot be over-estimated.

At present a very large proportion of rice in Bengal has to pass through milling process by which the bran is largely or entirely removed. This bran consists of the seed coat, the embryo and the greater part of the oily aleurone layer.

The proteins of rice and rice bran are credited with high biological value amongst cereals. Mitchell and Villegas [1923] give the value of bran protein

*Calculated from Frap's figures.

as sixty-eight. Maynard, Fronda and Chem [1923] have demonstrated a supplementary relation between the proteins of corn and rice bran. Boas Fixen [1934-35] states that Osborne and Mendel considered that rice bran and barley supported growth better than did oats and maize. According to West and Cruz [1933] rice bran is considered an excellent cattle food, being more nutritious than hydraulic copra cake, wheat bran, gram and straight grade flour. They further state that it has been estimated that thirty grms. rice bran provide sufficient vitamin B to those susceptible to beriberi.

According to various investigators—Suzuki, Yoshimura and Fugi [1909], Osborne and his co-workers [1915], Jones and his co-workers [1927]—the proteins of rice and rice bran include all important amino acids covering the requirements of maintenance and growth.

Rice bran is also very rich in oil (about twenty per cent in the samples used in the experiment under reference). Winton and Winton [1933] in their work "The Structure and Composition of Foods" have cited from various authors the different kinds of oil present in rice bran and it would appear from the same that the oil mainly consists of palmitic (eighteen to twenty per cent), oleic (forty-one to forty-seven per cent), linolic acids (thirty to thirty-seven per cent) and a fraction of other acids. It has been shown by Burr [1930] that linolic acid and possibly other fatty acids are essential constituents of the diet and that the absence of such fatty acids leads to kidney degeneration, failure of reproduction and other disturbances.

Taking all these facts into consideration rice bran would appear to be a feed of great promise especially in regard to organic nutrients. Its mineral composition however is of very interesting nature. It is unusually rich in phosphorus (over six per cent P_2O_5 in the sample used). Its magnesia content also is much greater (2·6 per cent) than many feeds but it is very poor in lime (only 0·2 per cent). Its lime-phosphorus ratio ($CaO : P_2O_5$) is about 1: 32, and in this respect it is highly imbalanced. Besides, the phosphorus in it is probably not in an assimilable form. As will also appear from the results of experiment described below, these two are probably the main factors in the way of its unsatisfactory assimilation.

In Bengal, the stuff is widely available and is sold at a cheap rate. The cultivators and cartmen feed it to their animals. Mr. Gossip, Live-stock Expert, Bengal, stated that at Ferozepur he had fed some three to three-and-a-half seers per animal but the feeding was attended with severe loss of condition, even resulting in the death of three animals.

The preliminary experiment conducted in Bengal has also given indication of unsatisfactory effects by its feeding. Nine country bullocks were fed with *Aman* rice straw *ad lib*, and with it rice *kura* was fed at a certain proportion of live-weight varying from 1250 grms. to 2000 grms. per 1000 lbs. The feeding lasted for about eighteen weeks commencing from the 15th January 1934 and terminating on the 20th May 1934.

There are two aspects from which the efficiency of the feed can be judged from external appearance :—One is appetite as will be indicated from the rate of consumption and the other is loss or gain in live-weights. It may briefly be stated that except for the first two weeks the consumption of straw fell markedly. This ranged from twenty per cent to over fifty per cent on the basis of the consumption of the first and last weeks as can be judged from the following.

TABLE II

Kura fed per 1000 lbs. live-weight grms.	Animal No.	*Kura* fed grms.	Percentage fall in straw consumption 1st and last week per cent	Loss or gain in live-weight 1st and last week
1250	D_5	675	23·21	— 9·2
	D_8	650	30·60	— 9·6
1500	D_1	806	23·86	+3·4
	D_4	880	32·54	— 37·0
	D_9	924	32·55	— 19·2
1750	D_3	1,000	20·90	+2·6
	D_7	900	52·40	— 18·8
2000	D_2	1,180	19·62	+3·4
.	D_6	1,208	29·62	— 12·4

It will be seen that the fall in the consumption of straw or the fluctuations in live-weight are hardly related either to each other or to the rate of *kura* fed under the four divisions. It shows that there was generally a marked disinclination for straw consumption and that the loss of weight was also equally marked in six out of nine animals while the nominal gain of the remaining three was at most of a stationary nature.

The cause of it might be associated with a deficiency or imbalance in energy supply, protein or mineral matter, either singly or in combination.

With respect to energy supply some deficiency was bound up with fall in the consumption of straw, but as the share of *kura* was generally consumed in full the actual deficiency was not very large. In fact, the total digestible nutrients and starch equivalents compare fairly well with the results of more balanced feeds as can be judged from Table III.

TABLE III

Kura per 1,000 lbs. live-weight	Animal No.	*Aman* straw and rice *kura*			*Aus* straw and linseed cake		
		Total digestible nutrients	Starch equivalent	Nutritive ratio	Total digestible nutrients	Starch equivalent	Nutritive ratio
		Lbs.	Lbs.	1 :	Lbs.	Lbs.	1 :
1250	D_5	6·888	4·540	32	7·131	4·841	12
	D_8	6·099	4·316	34	6·763	4·598	14
1500	D_1	6·570	4·634	25	..	..	..
	D_4	6·624	4·179	28	7·469	5·300	15
	D_9	6·687	4·556	26	7·551	5·423	15
1750	D_3	6·135	4·308	25	..	..	..
	D_7	5·982	4·142	25	..	..	..
2000	D_2	6·256	4·070	22	6·792	4·902	14
	D_6	5·628	4·311	24	6·134	3·954	11

There was thus no serious deficiency in energy supply.

In the case of protein also the supply at any rate did not seem to be low ; the balance figures were also positive in the case of seven out of nine animals. But about two-thirds to three-fourths of the amount ingested passed as undigested material through the faeces. Naturally the share of digestible nitrogen falling to the lot of each was low (about eight to ten grms.) and this was reflected in the nutritive ratio which varied from 1 : 24 to 1 : 34. If rice protein had a better biological value as is seen from the results of various workers there was no reason why the assimilation should be poor. The disturbed condition in the animal cannot therefore be explained from either any deficiency in energy supply or unsuitability of rice protein. Such an inference could have had some justification if the mineral side had been better balanced. But it seems that in this respect rice bran possesses certain characteristics quite distinct from others. It has been already stated that rice bran is very poor in lime and unusually rich in phosphorus resulting in a wide ratio (1 : 32) between them. This will be naturally reflected in the feed as can be judged from Table IV.

TABLE IV

Intake of nutrients computed on 500-lb. live-weight

(Symbols (+ —) indicate whether the balance was positive or negative)

Kura per 1000-lb. live-weight	Animal No.	CaO	MgO	K_2O	Na_2O	P_2O_5	Cl_2	Digested nitrogen	CaO : P_2O_5 1 :	CaO : K_2O 1 :	Nutritive ratio	Loss or gain in live-weight 1st and last week
1250 . .	D_5	18·227 –	27·387+	74·688+	17·210+	38·843 –	19·364–	9·196+	2·13	4·10	32	–9·2
	D_6	17·458 –	26·924–	71·868+	17·102+	38·906 –	19·218 –	7·835+	2·23	4·10	34	–9·6
1500 . .	D_1	18·024+	29·516+	74·950+	16·999+	44·446+	18·909 –	11·233+	2·46	4·17	25	+3·4
	D_4	16·231 –	27·413+	64·927+	16·845+	42·833 –	19·424+	9·957+	2·64	4·00	28	–37·0
	D_9	16·795 –	29·112+	70·599+	14·058+	45·465+	19·609 –	10·781+	2·71	4·20	26	–19·2
1750 . .	D_3	16·090 –	30·805+	65·771 –	17·293 –	51·655+	..	10·538+	3·02	4·08	25	+2·6
	D_7	15·394 –	30·104+	66·384+	15·839 –	50·169+	17·296 –	10·377+	3·26	4·31	25	–18·8
2000 . .	D_2	14·207 –	32·227+	59·876 –	16·525+	58·282+	17·179 –	11·598+	4·10	4·20	22	+3·4
	D_8	15·282 –	33·153+	63·706 –	17·041+	58·914+	17·951 –	9·624+	3·86	4·17	24	–12·4

In this table the major facts are epitomised and the total intakes of different nutrients are set up with their positive or negative symbols indicating the results of balances. The results are also computed on the basis of 500-lb. live-weight to facilitate a better comparison.

It will be noted from this :—

(1) that lime supply was low (fourteen to eighteen grms.) and eight out of nine have recorded a negative balance,

(2) that phosphate ingestion has been very high (thirty-nine to fifty-nine grms.) but in spite of such heavy ingestion three out of nine have recorded a negative balance,

(3) that CaO :P_2O_5 ratio has varied from 1 : 2 to 1 : 4 and CaO : K_2O ratio has been about 1 : 4,

(4) that like lime the chlorine balances have also been largely negative. The amount is slightly below the requirement,

(5) that magnesia ingestion also has been much higher (about 1½ to double) as compared to the other combinations so far tested at Dacca (except Guinea grass) and

(6) that digested share of nitrogen was low.

It has been already stated under " The Lime and Phosphorus Requirement of Bengal Cattle" that under the condition of rice straw feeding positive balance could not be attained until the ingestion was about twenty-four grms. CaO per 500-lb. live-weight. Here the amount was less by about a quarter. This factor by itself would thus react on the normal metabolism.

The large ingestion of phosphorus might suggest as being another contributory cause. But it has been found by workers like Cox and Imboden [1936] that excess of phosphorus was better tolerated than excess of lime. It has been stated under " The Lime and Phosphorus Requirement of Bengal Cattle " that the Bengal experiments show that the P_2O_5 requirement of Bengal cattle is about ten grms. But in the case of feeding with rice *kura* positive balance could not be attained until the ingestion was about 43 grms. P_2O_5. Another striking feature was that in the three instances of negative balance, aside from the amount excreted through urine, more P_2O_5 was voided through faeces above than was provided in the feed.

The cause of poor utilization of P_2O_5 from rice bran is in all probability associated with the fact that the phosphorus compound in it is chiefly in the form of phytin which is not readily assimilable. Rather [1918] determined the nature of phosphorus compounds in rice products and found that out of total phosphorus eighty-seven per cent existed as inosite penta phosphoric acid and nineteen per cent in inorganic combination in rice bran, while in rice polish the percentages were ninety-three per cent and ten per cent respectively. It will be seen that the inorganic portion is very low and it is the paucity of this which is probably mainly responsible for low assimilation. These aspects have been dealt with in greater

detail by Carbery, Chatterjee and Talapatra [1937] in their studies on mineral assimilations. Possibly, in the feeding experiments under review the inorganic portion reached the level of requirement at about the stage of 43 grms. ingestion of P_2O_5 (Table IV). At the same time it shows the very large proportion of phosphorus which is practically being wasted, and this point is deserving of close attention.

Reverting again to the behaviour of rice *kura* it may be stated that, apart from its rather peculiar complex of mineral combination, there are evidences suggesting that cereal diets appear to have deleterious effect on calcification. Holst [1927] reported a ricket-producing factor from oats which could be extracted with 0·5 per cent hydrochloric acid and Mirvish [1929, 1930] reported that when a dilute hydrochloric acid extract of oats was injected into animals it produced a marked fall in the blood calcium. Low and Steenbock [1936] found that the inorganic P content of the variously treated samples of maize bore a direct relation to the anti-rachitic effectiveness of the ration and an inverse relation to the phytin content, and that the hydrolysis of phytin by hydrochloric acid improved it to the extent of hydrolysis.

It is just possible that in the present experiment all these factors combined together to bring in a condition of physiological disturbance which was reflected in a low nitrogen assimilation, the negative chlorine balance and so forth. The loss of appetite as indicated from the decreased consumption of roughage was another manifestation of same.

We are thus faced with a problem of great economic and academic interest. On one side there is a large supply of a cheap and easily available cattle food which has apparently all the elements of nutrition, on the other side the feeding is followed by conditions which suggest the possibility of a complex combination. It offers an interesting field for study.

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GENETIC IMPROVEMENT OF WHEAT IN BOMBAY

I. BANSIPALLI—808

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Introduction

Wheat is one of the important staple crops in the province of Bombay. It occupied nearly 17,50,000 acres in 1934-35. Of this acreage, the Deccan claims nearly 60 per cent, Karnatak 30 per cent and the remaining area is mostly concentrated in the Bhal tract of Gujarat. (Fig. 1).

Over ninety per cent of the crop is grown dry, *i.e.*, in the *rabi* season. The crop is sown from October to November and harvested from February to March. The most extensively grown varieties belong to the species, *Triticum durum* Desf. In the Deccan the local wheat is known as Bansi or Pivala.

The genetic improvement of wheat has been in progress since 1918. The results of some improved strains have been published in Bulletin 166 of the Department, Nazareth [1931].

The present paper summarizes the behaviour of a new strain, Bansipalli-808.

History of the strain

Bansipalli-808 is a synthetic strain, having been evolved from a cross between Bansi-168 and Kala-Khapli-568. The former is a pureline selection from the local Bansi wheat. It was originally selected in 1919 by Chibber, who was the then Plant-Breeding Expert to the Government of Bombay, Bhide [1920-21]. Compared to local, Bansi-168 is an early wheat, and has attractive yellow grains and lustre. The plant has smooth brown glumes and awns. It is now a standard strain in West-Khandesh. The other parent, Kala-Khapli-568 is derived from a natural cross. The original plant was found by Chibber in a crop of ordinary Khapli and attracted attention due to its black awns. The plant

*Deceased.

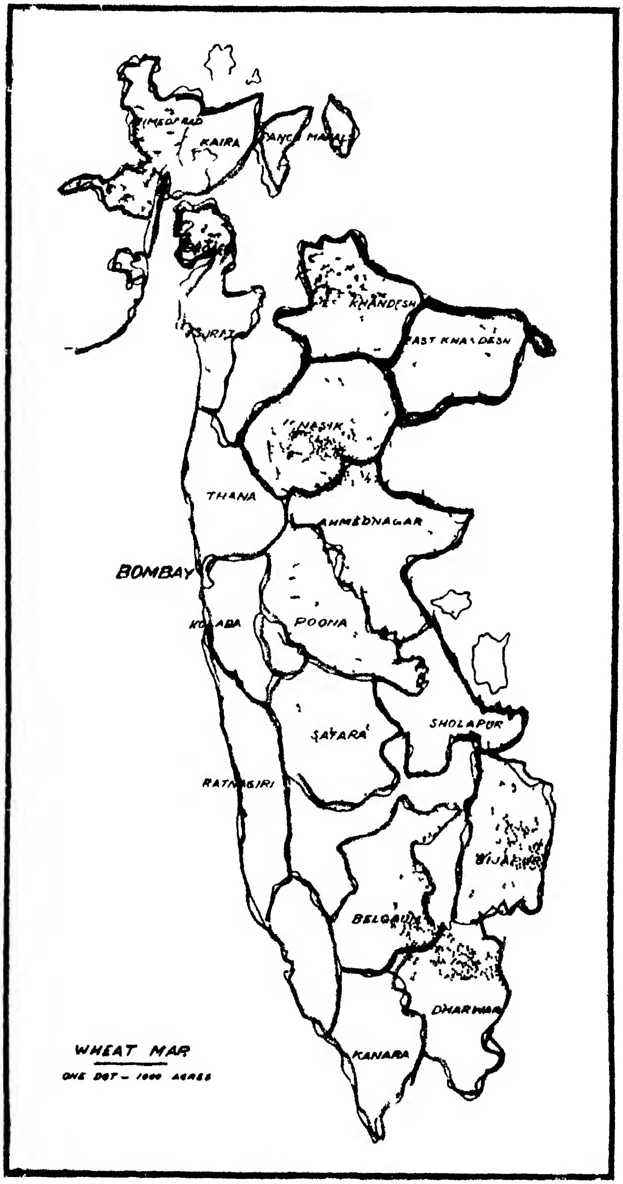


FIG 1.

Distribution of wheat acreage in Bombay

proved heterozygous for a number of characters and ultimately a strain, believed then to be resistant to black stem rust, was isolated by Bhide and named Kala-Khapli-568. It has been proved that besides Khapli, the other parent of Kala-Khapli-568 must have been Baxi [Kadam, 1936,2].

With a view to producing rust resistant varieties Bhide crossed the two varieties in 1923-24. Until the year 1929-30 the hybrid material was being purified. Ultimately four selections were secured for final trials on the experimental plots and in the districts. These were named 806, 807, 808 and 809, [Kadam, 1929-30]. These strains and some pure Bansi selections were compared in the various major zones of the province until 1935. Out of these, Bansipalli-808 emerged as the most successful wheat.

BOTANICAL AND AGRONOMIC CHARACTERS

Bansipalli-808 is an early maturing variety. It flowers from sixty to sixty-five days after sowing and ripens in ninety to ninety-five days. The plant of Bansipalli-808 is short in stature and is conspicuous in the field due to its broad leaves. It has glabrous white glumes and white awns. The grain is large, light yellow and lustrous. It is characterized by abruptly pointed ends. (Plate XXV).

Bansipalli-808 was closely studied during the years 1933-34-35. The data on various characters are summarized, along with the local, in Table I.

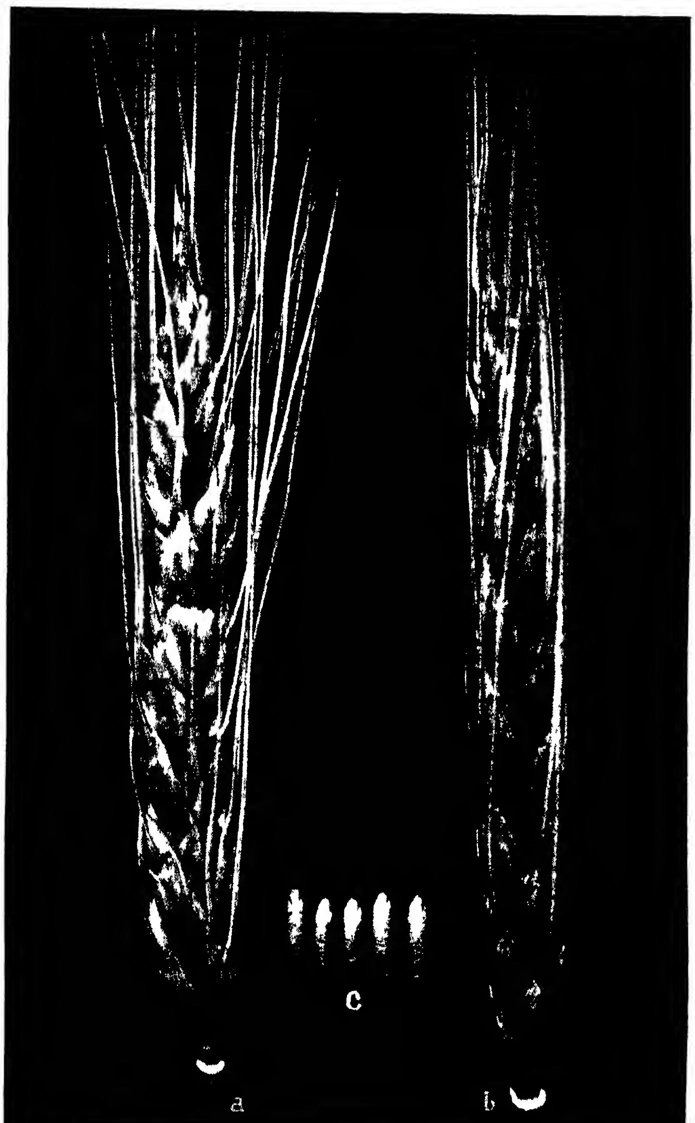
TABLE I

Botanical and Agronomic characters of local Bansi and Bansipalli-808

No.	Characters	Year	Local			808		
			Range	Mode	Mean	Range	Mode	Mean
1	Days from sowing to heading.	1933-34	64—70	75	72·6±·41*	54—77	59	60·3±·59
		1934-35	65—76	71	70·7±·22	56—73	63	61·0±·33
		1935-36	60—82	75	76·0±·41	60—73	63	65·1±·42
2	Tillers per plant .	1933-34	1—7	3	3·20±·15	1—10	4	4·18±·31
		1934-35	1—14	6	6·04±·24	1—15	7	6·40±·32
		1935-36	1—26	10	8·40±·77	1—24	10	9·00±·73
3	Length of main spike in cms.	1933-34	4·1—10·0	8·0	7·4±·11	5·1—10·0	7·0	7·1±·13
		1934-35	6·5—10·5	9·0	8·6±·08	4·5—10·5	8·0	7·6±·09
		1935-36	5·1—11·0	9·0	8·6±·17	3·1—10·0	9·0	8·6±·14
4	Spikelets on the main spike	1933-34	10—17	15	13·9±·18	8—15	13	11·7±·19
		1934-35	10—21	19	17·6±·17	9—18	13	13·2±·14
		1935-36	8—19	16	14·7±·40	7—18	14	13·9±·28
5	Density of the main earhead in cms.	1933-34	0·45—0·59	0·53	0·53±0·003	0·48—0·74	0·62	0·60±0·006
		1934-35	0·43—0·64	0·50	0·49±0·003	0·40—0·67	0·62	0·58±0·004
		1935-36	0·42—0·65	0·53	0·56±0·007	0·48—0·68	0·59	0·60±0·005
6	Grains per grm.	1933-34	19—30	22	23·4±·28	17—28	22	22·2±·33
		1934-35	18—27	21	22·5±·77	18—30	22	23·4±·26
		1935-36	17—28	21, 22 & 24	22·7±·41	18—30	19 & 20	20·6±·95

* Standard errors.

BANSIPALLI — 808



(a) Front view of the panicle, (b) Side view, (c) Grains.

No.	Characters	Year	Local			808		
			Range	Mode	Mean	Range	Mode	Mean
7	Length of grain in mms.	1933-34	6·7—8·4	7·8	7·8±·03	7·3—9·0	8·1	8·2±·04
		1934-35	7·1—8·6	8·1	7·9±·03	7·4—8·9	8·4	8·2±·03
		1935-36	7·2—8·6	7·7 & 8·0	8·0±·71	8·1—9·5	8·6	8·8±·54
8	Breadth of grain in mms.	1933-34	2·0—3·7	3·1	3·0±·03	2·0—3·4	3·1	2·9±·03
		1934-35	2·4—3·6	3·4	3·2±·02	2·1—3·6	3·1	2·9±·03
		1935-36	2·3—3·7	3·1	3·2±·41	2·6—3·4	3·1	3·2±·09
9	Yield of grain per plant in grms	1933-34	2·5—10·0	2·5 & 5·0	4·2±·61	2·5—15·0	2·5	5·6±·47
		1934-35	2·5—32·5	7·5	9·7±·37	2·5—32·5	5·0	10·4±·62
		1935-36	2·5—37·5	10·0	12·0±1·10	2·5—47·5	15·0	14·5±1·4
10	Weight of 1000 grains in grms.	1936-37	36·9—40·9	.	39·2±0·39	45·4—48·4	...	46·9±0·3
11	Bushel weight in lbs *	1936-37	66·32—67·73	...	67·17±0·178	65·75—67·73	...	66·6±0·16

It will be seen from the above table that the improved strain is earlier to local by ten to fifteen days. In tillering and yield it is slightly better than the local variety. The grain of Bansipalli-808 is larger and much heavier than that of the local, although it is not as broad as that of the latter. The local variety has slightly more number of spikelets and has a denser panicle than the synthetic wheat.

It is interesting to note that although the grain of Bansipalli-808 is longer and heavier than the local Bansi, the bushel weight is lower than the local. This is due to the shape of the grain of the improved wheat. The grains of the new wheat are long and consequently they do not fill up the measure so compactly as those of the local, which has short plump grains. As a result there are fewer grains of Bansipalli-808 in a half-pint measure than that of the local.*

Experiments on the farm

During the years 1931-32 to 1934-35 Bansipalli-808 was compared in random replications along with a number of other improved strains and with the local Bansi at the Cereal Breeding Station, Niphad.

In the year 1931-32 Bansipalli-808 was replicated six times on one *guntha* plots with Bansipalli strains 806, 807, 809, 907, Pusa-4 and local Bansi. The experiment indicated significant strain differences. The Bansipalli strain 809 and the local proved significantly superior to the general mean. The strain 907 and Pusa-4 were significantly lower in yield, while Bansipalli-808 was slightly below the general mean. [Kadam, 1931-32].

* Bushel weight was determined from a half-pint measure.

In the year 1932-33 various improved strains were compared in Latin square on one *guntha* plots. These were the Bansi strains, 103, 162, 168 and 224, the Bansipalli strains 808 and 809, Pusa-4 and the local Bansi. Due to abundant moisture the crop was excellent and the yields were very high. None of the strains, however, proved significantly superior to the general mean of the experiment. Bansipalli-808, however, gave better yield than the local, which was one of the low yielders, [Kadam, 1932-33].

The same set of strains as in the previous year was compared in a Latin square in 1933-34. The crop of the season was poor, due to a number of factors. The experiment showed significant yield differences. The Bansipalli strain, 808 and 809, and Pusa-4 being significantly inferior, in the order stated, to the general mean, [Kadam, 1933-34].

Out of the three years, only once Bansipalli-808 gave better yield than the local. Considering the average yields, the local exceeded Bansipalli-808 by seventy-five and eighty-nine lbs. per acre in 1931-32 and 1933-34 respectively, while the latter gave more yield by 45 lbs. over the former in 1932-33. The general averages for the three years of local and Bansipalli-808 were 733 lbs. and 693 lbs. respectively, the former out-yielding by 40 lbs. only.

District trials

Although Bansipalli-808 was not better in yield to local when compared on the farm its earliness and better grain characters made it desirable to undertake trials in the districts. From 1931-32 to 1935-36 Bansipalli-808 was compared with the local wheat in the Nasik district of the North-Central division and at various places in the Southern division. The comparisons in these divisions are now discontinued and the strain is now a standard in both the tracts. Since 1935-36 yield trials of Bansi-168, Bansipalli-808 and Bansipalli-809 have been recommenced in Ahmednagar district. Trials previous to 1935-36 season were taken, but reliable results could not be obtained due to frequent changes in the personnel of the Agricultural Overseer, Nagar. The two years' trials, in 1935-36 and 1936-37, have, however, unquestionably demonstrated the superiority of Bansipalli-808 over the local wheat and the companion strain. The district results for each tract are given below separately.

Trials in the Nasik district.—During the five years, 1931-35, Bansipalli-808 was compared twenty-nine times with the local Bansi wheat in various talukas of the Nasik district, [Kadam, 1931-35]. The results are summarized taluka by taluka in Table II.

TABLE II

*Village trials of Bansipalli-808 conducted in the district of Nasik during the years 1931-32 to 1935-36**

Serial No.	Place	Taluka	Year	Yield per acre in lbs. Bansipalli-808	Yield per acre in lbs. Local	Increase or decrease over local in per cent
1	Vadgaon . .	Sinnar .	1931-32	800	560	42·86
2	Lonarwadi .	Do. .	1932-33	550	No	comparison
3	Ditto	Do. .	1932-33	506	425	19·06
4	Khopdi . .	Do. .	1932-33	400	360	11·11
5	Dharangaon .	Do. .	1933-34	595	520	14·42
6	Pangari . .	Do. .	1934-35	700	680	2·94
7	Ditto .	Do. .	1934-35	600	620	—3·23
8	Marhal . .	Do. .	1934-35	800	760	5·26
9	Khopdi . .	Do. .	1935-36	600	580	3·45
10	Kirsavli . .	Do. .	1935-36	500	460	8·69
11	Khadavli . .	Do. .	1935-36	450	400	12·50
	Averages .	..	..	591·00	536·50	10·16
12	Ambevani .	Dindori .	1931-32	960	480	100·00
13	Ditto .	Do. .	1932-33	560	560	Equal
14	Ditto .	Do. .	1932-33	540	612	—11·76
15	Khedgaon .	Do. .	1935-36	320	320	Equal
	Averages .	..	..	595·00	493·00	20·69
16	Pimpalgaon .	Niphad .	1931-32	720	480	50·00
17	Ditto .	Do. .	1932-33	720	880	—18·18
18	Ditto .	Do. .	1932-33	420	448	—6 25
19	Vinchur . .	Do. .	1933-34	640	560	14·28
20	Pimpalgaon .	Do. .	1933-34	560	600	—6·66
21	Ravlas . .	Do. .	1933-34	680	672	1·20
22	Bharwas . .	Do. .	1934-35	560	560	Equal
23	Chanduri . .	Do. .	1935-36	492	484	1·65
24	Shervade . .	Do. .	1935 36	264	264	Equal
	Averages .	..	..	562·00	550·00	2·18
25	Nasik . .	Nasik .	1934-35	480	400	20·00
26	Gangapur .	Do. .	1935-36	444	428	3·74
	Averages .	..	..	462·00	414·00	11·59
27	Kavithkhede .	Nandgaon	1934-35	240	240	Equal
28	Bolthan . .	Do. .	1934-35	756	711	6·33
29	Ditto .	Do. .	1934-35	300	242	24·00
30	Rohile . .	Do. .	1934-35	319	272	18·00
	Averages .	..	..	404·00	366·00	10·38
	General averages	..	..	523·00	472·00	10·80

* The writers are indebted to Mr. C. S. Patel, formerly Deputy Director, for undertaking trials and to Mr. K. V. Joshi for continuing the same in the North-Central division. They also greatly appreciate the willing help rendered by the district officers.

It will be seen from the above table that out of twenty-nine comparisons Bansipalli-808 shows higher yields nineteen times, is equal to local in five cases and gives lower yields in five cases only. The general average increase of Bansipalli-808 over the local per acre is nearly 11 per cent.

Trials in the Southern division.—The two Bansipalli strains, 808 and 809 and Bansi-103 were given trials for a number of years in the Southern division. Of these, Bansi-103, although higher yielding than the local, proved unsuitable due to its late maturity. Bansipalli-809 was not as good as the sister strain 808, [Kadam, 1931-35]. The results of Bansipalli-808 and of the local only are, therefore, shown in Table III.

TABLE III

*Village trials of Bansipalli-808 conducted in the districts of Dharwar, Bijapur and Belgaum during the years 1931-32 to 1935-36**

Serial No.	Place	Taluka	District	Year	Yield per acre in lbs. 808	Yield per acre in lbs. Local	Increase or decrease over local in per cent
1	Dharwar Farm	Dharwar .	Dharwar .	1931-32	164	11.56	Badly rusted
2	Aigali .	Athani .	Belgaum .	1932-33	768	480·00	60·00
3	Honganhalli	Bijapur .	Bijapur .	1932-33	480	473·00	1·50
4	Sirur . .	Bagalkot .	Bijapur .	1934-35	148	140·00	5·71
5	Galgali .	Bilgi (Peta)	Bijapur .	1934-35	320	280·00	14·29
6	Shedbal .	Athani .	Belgaum .	1935-36	192	144·00	33·33
7	Musuguppi	Gokak .	Belgaum .	1935-36	148	119·00	24·37
8	Ulligeri .	Saundatti	Belgaum .	1935-36	234	223·00	4·93
9	Inamhongal	Saundatti	Belgaum .	1935-36	260	200·00	30·00
10	Murgod .	Saundatti	Belgaum .	1935-36	512	488·00	4·91
11	Basapur .	Navalgund	Dharwar .	1935-36	576	256·00	125·00
12	Bijapur .	Bijapur .	Bijapur .	1935-36	453	304·00	49·01
	Averages .	..	..	..	372	282·00	31·90

* Thanks are due to Rao Bahadur S. S. Salimath, Deputy Director, for undertaking trials in the Southern division and to his district officers for supervising the field experiments.

The trials in 1931-32 and in 1933-34 were vitiated by a heavy rust attack. The grain in the former year was so shrivelled that it was unfit for human use. The yields for 1933-34 are not available.

It will be seen that in all cases the improved strain has given more yield than the local variety. The increases in outturn range from 1·5 per cent to as much as 125 per cent. The average increase in yield of Bansipalli-808 is nearly 32 per cent.

Trials in the Ahmednagar district.—Bansi-168, Bansipalli-808 and Bansipalli-809 were compared with the local Sudhe wheat during the years, 1935-36 and 1936-37. In the former season comparisons were made only at four places. As the improved strains appeared promising the comparisons were extended to ten places in 1936-37. Of the three strains, Bansipalli-808 has proved the best due to its earliness, large and lustrous grains and good yields, [Kadam, 1935-37]. In view of this the behaviour of Bansi-168 and Bansipalli-809 is not shown in the following table as it has been definitely decided to withdraw them from trials. The yield behaviour of Bansipalli-808 and local Sudhe wheat is shown in Table IV.

TABLE IV

Village trials of Bansipalli-808 conducted in the district of Ahmednagar during the years 1935-36 and 1936-37 (a)

Serial No.	Place	Taluka	Year	Yield per acre in lbs. 808	Yield per acre in lbs. Local	Increase or decrease over local in per cent
1	Kanhur . .	Parner .	1935-36	560	316	77·21
2	Nagar . .	Nagar .	1935-36	660	319 (Baxi)	106·89
3	Bhadgaon .	Shevgaon .	1935-36	613	580 (Baxi)	5·69
4	Shrigonda .	Shrigonda	1935-36	384	220	74·54
5	Gargundi . .	Parner .	1936-37	345	*120	187·50
6	Gargundi . .	Parner .	1936-37	450	*119	278·15
7	Kanhur . .	Parner .	1936-37	365	*110	231·82
8	Kanhur . .	Parner .	1936-37	375	†25	..
9	Ourangpur .	Akola .	1936-37	616	580	6·21
10	Thugaon . .	Akola .	1936-37	528	396	33·33
11	Ghodegaon .	Newase .	1936-37	500	320	56·25
12	Khadke . .	Newase .	1936-37	400	150	166·66
13	Newase . .	Newase .	1936-37	520	360	44·44
14	Tarawdi . .	Newase .	1936-37	360	200	80·00
	Averages .	..	..	477	272	75·00

(a) We are beholden to Mr. V. V. Gadgil, Deputy Director, for conducting trials in the South-Central division. Our thanks are also due to Mr. R. D. Khandekar, Agricultural Overseer, Ahmednagar, for personally supervising the trials.

* Partial failure of the crop due to low moisture.

† Complete failure of the crop due to low moisture.

During 1935-36 Bansipalli-808 was compared against Baxi and Sudhe varieties under dry conditions. The former is an irrigated variety and is very late com-

pared to the improved strain, while the latter is a dry wheat. It will be seen that at Nagar, where there was deficiency of moisture, Baxi could not compete with Bansipalli-808. At the other two places, Kanhur and Shevgaon, the local dry wheat, Sudhe, has fared very badly as compared to the synthetic strain.

The outstanding differences between the two wheats during 1936-37 are mainly due to seasonal conditions. In this year the monsoon was almost a complete failure, there being practically no rain in *kharif* season. Fortunately, late in November, three to four inches of rain fell and this enabled wheat sowing in the beginning of the last week of the month. After this, there were no rains, and the wheat crop had, therefore, to grow on a rainfall of three to four inches only. Thus the comparisons of Bansipalli-808 with local during the season of 1936-37 were most severe.

Defects of Bansipalli-808

1. *Tillering*.—There is a general impression among the Nasik farmers that Bansipalli-808 does not tiller as much as the local wheat. This is probably due to the fact that a crop of the improved wheat appears sparser due to thinner sowing brought about by the larger size of grain. It is, therefore, better to increase the seed rate of Bansipalli-808 by three to five lbs. where the local is sown at forty lbs. per acre. This equalizes more or less the number of seeds sown per acre. It should be pointed out, however, that the improved wheat is not lower in tillering to the local wheat under both the dibbled and field conditions. In the former case the tillering of Bansipalli-808 is actually more, although the difference is not much (Table I). During the season of 1936-37 statistical studies in tillering of a number of wheat strains, including Bansipalli-808, were made at the Cereal Breeding Station, Niphad. By the method of analysis of variance it was found that Bansipalli-808 is not inferior in tillering to the local wheat under field conditions.

2. *Difficulty in threshing*.—Another complaint against the improved strain is that it is slightly more difficult to thresh than the local Bansi. This is true. Bansipalli-808 is a derivative from a cross involving a synthetic Khapli, which has brittle rachis and tightly fitting glumes. The improved strain, therefore, possesses Khapli blood to a certain extent and this makes it slightly more difficult to thresh, although it has tough rachis and easy shelling glumes. The defect, however, is so slight that it is of no consequence. Its *bhusa* is also said to be inferior to that of the local. This is due to lower number of leaves in plants of Bansipalli-808.

3. *Susceptibility to black rust of wheat*.—The cross of Bansi-168 and Kala-Khapli-568, from which Bansipalli-808 is derived, was originally made with the purpose of obtaining rust-resistant selections. It was then thought that Kala-Khapli-568 was a resistant variety and crosses of it with Bansi strains would result in resistant derivatives. Bhide, [1923-24.] Unfortunately, out of the six forms Kala-Khapli-568 has proved susceptible to four, XV, XXIV, XL and XLII and is resistant in

the seedling stage to the two forms XXI and LXXV.* This is not surprising since K. K.-568 is itself a product of a natural cross between the true Khapli and Baxi wheat, the latter being susceptible to all these forms of rust. Bansipalli-808 has, however, inherited seedling resistance to forms XXI and LXXV, but is susceptible to other forms. Therefore, it cannot be regarded as a resistant wheat. If sown early, it may, however, escape rust as it matures ten to fifteen days earlier than the local wheat.

4. *Hardness of grain.*—In the Southern division of the province, the grain of Bansipalli-808 is not considered to be as hard as that of the local red wheat. The grain is unsuitable for making certain local dishes, but for *chapatees* it is preferred to the local variety.

5. *Injury by frost.*—In the central portion of Nasik district frost sometimes prevails in mid-January. In these parts wheat is sown late. Bansipalli-808, being early, comes in dough stage much earlier than does the local. The periods of grain formation of the improved wheat and of frost coincide with the result that the development of the grain is affected. It is, therefore, necessary to adjust the sowing of Bansipalli-808 in this part of Nasik in such a way that the grain formation period will occur either later or sufficiently earlier to escape damage from frost. Studies in growing Bansipalli-808 at various periods from mid-October upto late in November have shown that no critical differences in yields of different periods of sowings occur, indicating possibilities of adjusting time of sowing properly. In fact the value of the improved wheat in central Nasik has been realized both by the farmers and by the propaganda staff of the North-Central division as evidenced by a demonstration of Bansipalli-808 organized at Krishnagaon, Dindori taluka, during mid-January 1937.†

Discussion

The problem of replacing the local wheats by better varieties in the Nasik and Ahmednagar districts and Karnatak has been partly solved by the introduction of Bansipalli-808 in these regions. This wheat is not only a better yielder, but fetches higher prices due to superior grain characters over the local wheats. In the Deccan districts an early wheat is a prime necessity and in this respect Bansipalli-808 admirably suits the requirement. If sown in time—about mid-October—it ripens before the advent of cold and black stem rust. But when sown late it suffers from frost. This is usually the case in the Central part of Nasik. The problem, therefore, is to evolve a frost-resistant variety which would be suitable to this portion of Nasik. This can be achieved by hybridization with frost-resistant durums and selecting suitable hardy types. The task, however, is very

* So far six forms of stem rust of wheat have been found in India. Seedling reaction of our wheats to these forms was tested by Dr. K. C. Mehta, Agra, to whom our thanks are due.

† *Dnyanprakash*, February 21, 1937.

difficult, if not impossible, in the absence of facilities to determine frost-resistant quality in hybrid material. In view of this, the only alternative is to conduct trials of new strains in the proper tract and by experience to select a suitable variety.

Another pressing need of the Nasik district and indeed of most of the wheat growing tracts of the province is rust-resistant varieties. In this respect none of the cultivated wheats, except Khapli, is resistant to black stem rust. The problem is somewhat complicated due to the existence of various physiological races of the rust. Fortunately, the importance of the problem is now generally recognized and there are indications that we will soon possess necessary equipment to undertake breeding of rust-resistant varieties.

The acceptance of Bansipalli-808 in Karnatak is half-hearted, although the strain is undoubtedly high yielding. But high yield is only one of the requirements the local farmer desires there. In addition, a strain must be early, even earlier, than the local and should possess very hard flinty grains. In these respects Bansipalli-808 does not come up to expectation. The problem of introducing earlier wheats and yet better yielding may be solved as we have now such types which may prove suitable to Karnatak. The Deccan Bansi, however, is not considered as hard in grain as the local red wheat of Karnatak, and this demand can only be met by improving the local red wheat. This will be the best solution since an improved red wheat will serve specific requirements which a white-grained wheat would not. Improved strains of both white and red wheats would act as complementary and would meet most of the requirements of the wheat farmers of Karnatak.

The Ahmednagar district is a tract of precarious rainfall. Early ripening character, therefore, greatly enhances the value of an improved crop strain. Bansipalli-808, in this respect, has amply proved worthy, even in so short a period as two seasons. The new variety can now be spread confidently as a dry wheat.

Each of the two Deccan districts, Nasik and Ahmednagar, and the two wheat districts of Karnatak, Bijapur and Dharwar, claims more or less twelve to sixteen per cent of the total area under wheat in the province of Bombay. Together, they represent nearly fifty-five to sixty per cent of the total area, or 987,178 acres. Bansipalli-808 has thus vast possibilities of expansion.

Summary

1. A new wheat, Bansipalli-808, is described. It was evolved from a cross between Bansi-168 and Kala-Khapli-568.

2. The synthetic wheat is earlier by ten to fifteen days to the local wheat. Its grain is larger and has a more attractive yellow colour than the local. Bansipalli-808 has glabrous white glumes and awns.

3. The new wheat has proved suitable to Nasik district, especially to the southern and eastern portions and to the wheat tract of Karnatak. It is also suitable to Ahmednagar district.

4. Bansipalli-808 is slightly more difficult to thresh than the local wheat. It is likewise susceptible to black stem rust. Its grain is not as hard as the local red wheat of Karnatak. In the central portion of Nasik it is said to be injured by frost more than the local wheat.

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PROBLEMS OF POTATO BREEDING IN INDIA

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Imperial Economic Botanist

PART I

PART I

Introduction

The principal aim in potato breeding is the improvement of its yield. Yield is a very complex character, depending upon the interaction between many factors within the plant and its environment, the latter controlled to no small extent by agricultural practice. A large share of the reduction in yield which commonly occurs is caused by one or other of the many diseases to which the potato plant is susceptible. For example, the annual loss in Europe due to Late Blight (*Phytophthora infestans*) alone is about ten to fifteen per cent of the crop. Virus diseases are also very destructive whilst considerable loss to the potato crop is caused by wart disease (a disease which is not known in India), potato scab, *Rhizoctonia* wilt, frost, drought and insect pests.

An admirable account of the potato in its early home and its introduction into Europe has been given by Salaman [1937, 1]. In the early history of potato cultivation in Europe much emphasis was placed on cultural practices. Breeding was confined to the use of parental varieties already cultivated in Europe and North America. In the present century, stimulated by the Russian and other expeditions to South America—the original home of the potato—a much wider

range of material has become available providing a remarkable impetus to research on the breeding, genetics and cytology of the potato. The early stock of European potatoes was derived from a restricted source consisting of a few varieties of *Solanum tuberosum*, and did not represent all the genetic possibilities of the potato. According to Bukasov [1932] a limit in the improvement of the potato had been reached; in the production of new varieties all the possible combinations of the same old parents had been tried and "a *cul-de-sac* had been reached with many problems still unsolved, such as blight and virus diseases." Thus, there was a need for a wider range of new materials to meet the greatly diversified demands of breeding for different regions; such a richness of material could be best found in the home or centre of origin of the potato. Accordingly, the Russian expeditions proceeded to America and searched the countries of Mexico, Guatemala, Columbia, Equador, Peru, Bolivia, Chile and Argentina, bringing home more than a thousand specimens of tuber-bearing solanums. The discovery of this wealth of new material has thus opened up new possibilities for the improvement of the cultivated potato.

The potato material collected by the various expeditions from Russia, Germany, the United States and Sweden comprises a large number of widely different wild and cultivated varieties. Species with different chromosome numbers, *viz.*, $2n=24$, $2n=36$, $2n=48$, $2n=60$ and $2n=72$ have been discovered. The European and North American cultivated potatoes all belong to the $2n=48$ class, but the existence of various wild species with other chromosome counts was known long before the Russian expeditions.

The new stocks are distinguished by many other characters such as those with dominant colour in tuber and flower, different ranges of photoperiodism and adaptability, differences in resistance to low temperature and, above all, differences in resistance to the assaults of blight.

The South American species, *Solanum Rybinii*, is said to be possessed of resistance to virus diseases to which all the domestic potato varieties are susceptible, with the exception of the seedling variety 41956 produced in the United States which exhibits a resistance against the X virus. Types with high as well as low contents of protein and starch, short and long rest period, and several other useful qualities, are also included in the collections. The species *S. phureja* is said to be capable of growing in hot valleys at much lower altitudes than the other species and is one of the few potatoes in which tuber formation is not impeded by hot, humid, sub-tropical conditions. The various forms of *S. andigenum* which exhibit a wide range of adaptability also merit serious investigation.

With the use of the Central and South American materials considerable success has already been achieved in the breeding of potatoes for resistance to Late Blight. Dr. Salaman of Cambridge University, who had worked on the genetics and breeding of potatoes for many years, has recently obtained very promising

results from hybrids with *S. demissum* [Salaman 1934; 1937, 2]. A good deal of work has also been done in this direction at the Institute of Plant Breeding at Müncheberg (Germany) and by Professor Reddick at Cornell [1934].

In Russia, Bukasov [1936] reports hopeful results in the use of the new material in breeding for increased productivity.

Potato breeding in India

(i) *Historical*

According to Watt [1908] the first mention of the potato in India occurs in Terry's account of the banquet at Ajmer given by Asaph Chan to Sir Thomas Roe in 1615, and Fryer in 1675 described the gardens of Surat and the Karnatak as containing, among other vegetables, brinjals (*Solanum Melongena*) and potatoes.

To-day, the potato may be said to be cultivated to a greater or lesser extent in all parts of India, both in the plains and in the hills up to an altitude of about 9,000 feet. In the plains the potatoes are grown mainly in the countryside near the cities where there is a ready market; in the hills the cultivation is more extensive, such as on the Khasi and Garo Hills, and the Himalayas at Darjeeling, in Nepal, Garhwal, Kumaon, Simla, Kangra, Kulu and Kashmir. Again on the tableland and on the lower hills of the central and southern tracts of India extensive cultivation of potatoes occurs, the produce being largely exported to the plains.

Although definite figures of potato production in the various provinces and States in India are not yet available, there is no doubt that the potato has already established itself as an important crop. In some parts of India it is often the only vegetable available to the poorer classes for the greater part of the year; the crop is used almost entirely for human consumption.

(ii) *The problems in India*

Disease.—The problems of potato breeding in India are very similar to those of Europe and America. In the hills where the potato, essentially a plant of temperate climes, is extensively cultivated, Late Blight is liable to destroy the crop. In the plains the crop is generally free from this disease as the high summer temperature kills the fungus; if, however, potatoes are imported from the hills late in the year and sown when lower temperatures prevail epidemics of Late Blight may occur. Early Blight due to *Alternaria solani* is common both in the hills and the plains. Virus diseases, especially those of leaf roll and mosaic, common in the hills and the plains, are particularly widespread in the latter, particularly in those districts where the seed is not regularly renewed from outside. Wilt diseases and ring disease (*Bacterium solanacearum*) also cause much loss. Wart disease fortunately does not occur in India.

While, in respect of diseases of the growing plant, the problems in India are similar to those of foreign countries, there is the added complication of the extensive

rotting of the tubers in storage which the hot Indian summer favours. The problem of potato storage has received considerable attention in India but it cannot yet be said to have been satisfactorily solved. While it has been found that storage at a low temperature is the most successful method of preventing loss, it has not been found possible to devise such refrigerated storage at a cost within the means of the average grower or dealer. The solution of the problem may lie in the development of varieties capable of withstanding high temperatures in storage. Preliminary work has indicated that wide differences exist in this respect between the varieties cultivated in India.

Insect pests—Considerable damage is done to the growing crop by cutworms (species of *Agrotis, etc.*) and the larvae of the *Epilachna* beetle. These pests are however comparatively unimportant. The main loss from insect agencies is occasioned by the Potato Moth (*Phthorimaea operculella*) which lays its eggs in the tubers. The caterpillars which hatch out of the eggs make winding burrows through the tubers. Apart from the damage actually done to the tuber, the tunnels made by the larvae facilitate the entry of rot-inducing fungi and bacteria.

Tuber dormancy—In several parts of India two to three crops are raised in the year. Under such conditions the tubers from the crop which has been harvested cannot as a rule be used for sowing the next crop, owing to the dormancy of the tuber buds. The dormant or rest period is usually two to three months but may be longer. Physical and chemical methods of breaking the rest period are known but the use of these is not practicable under ordinary conditions of farming in India. There is a need therefore for developing varieties with a short dormant period for use in such areas. Among the newly discovered South American species a few are known to have but little or no dormancy. There is thus some hope that this particular problem may be solved by hybridization. It is possible that we shall find that varieties with a long resting period, such as *S. andigenum*, may be more resistant to storage rots than the varieties which have been in use so far.

Photoperiodism—In Europe and America, potatoes are normally cultivated in the summer. In India, however, in the plains, potatoes are mainly grown as a *rabi* (cold season) crop. Unlike the varieties of *S. tuberosum* which are commonly grown in Europe and North America, all of which are long-day varieties, most of the South American potato species are adapted to short-day conditions under which they produce their maximum tuber production. It is possible that among these one may discover some especially suitable for Indian conditions.

Resistance to frost—While damage due to frost is negligible in Southern and Eastern India, it is of some importance in Northern and Western India. The creation of varieties which would unite resistance to cold with other economically desirable characters is therefore a desideratum.

Quality and yield—As potatoes are mainly consumed in the form of curries, etc., the question of table quality does not loom so large in India as in Europe.

The yield problem, however, is a very prominent one. As a rule the average yield in India falls far short of that in Europe and America. This is no doubt in great measure due to the high incidence of diseases, lack of adequate manuring and perhaps the want of varieties really suited to the conditions obtaining in this country. It should be remembered that all the varieties under cultivation in India have been imported and were evolved primarily to suit the conditions of the country in which they were bred. This problem therefore merits close attention.

(iii) Material available for breeding

The potatoes at present commonly cultivated in India are either imported European and North American varieties *e g.*, Up-to-date, Great Scot, Kerr's Pink, etc., or the so-called *desi* (country) varieties. The latter are doubtless imported varieties of which the original names have been lost, and which have become acclimatised. It is unlikely that locally raised seedlings have played any part in this, as most of the cultivated varieties are partially or completely sterile and work on potato-breeding in India has been negligible. The *desi* varieties (Patna White, Gola, etc.) may form good material for crossing with the new imported species as they represent varieties which have stood the test of time.

At the Imperial Agricultural Research Institute and its Potato Breeding Sub-station at Simla, a large number of samples of potatoes, collected from all parts of India with the help of the Directors of Agriculture of the provinces, has been under study with a view to determining how many distinct varieties are cultivated and which of these are useful for breeding. Material of the new South American and Central American species has also been received, thanks to the courtesy of agricultural botanists in Britain, America, Germany and Russia. Special mention must be made of Dr. P. S. Hudson of the Imperial Bureau of Plant Genetics and Dr. R. N. Salaman of the Potato Virus Research Institute, Cambridge, who have shown particular interest in the work and have rendered valuable assistance in procuring potato material. The following species are under study at Simla:

S. andigenum

S. Antipoviczii

S. aracc-papa

S. Caldasii

S. Candelarianum

S. chacoense

S. Commersonii

S. curtilobum

S. demissum

S. edinense

S. Fendleri

S. goniocalyx

S. Jamesii

S. leptostigma

S. Maglia

S. neoantipoviczii

S. otites

S. polyadenium

S. phureja

S. stenotomum

S. subtilius

S. tuberosum (from Chile)

Tuber and seed material of hybrids between *S. tuberosum* and other species (especially *S. andigenum*) has also been received. Until this material is multiplied it is not possible to undertake tests of resistance to diseases, etc. Such tests, however, will before long be carried out with the co-operation of the Mycological Section of the Imeprial Agricultural Research Institute.

(*iv*) *Methods of breeding*

For the production of new varieties it is necessary to raise plants from true seed because, except for the rare cases of somatic or bud mutations, plants propagated vegetatively remain true to type. The common cultivated potato being a highly heterozygous plant, a considerable diversity of types may be obtained merely by sowing its selfed seed, and this diversity is of course further increased by hybridization with other species thus providing the breeder with ample material to select from. As the potato is a vegetatively propagated plant, once a desirable seedling is secured it can be multiplied immediately for distribution.

Intensive breeding work with the common cultivated potato (*Solanum tuberosum*) has long been in progress in Europe and America and all the varieties in use have been produced from seeds obtained by crossing or selfing existing varieties. As already mentioned, a stage has been reached at which no further radical improvement can be expected by these methods. With the discovery in South America of a large number of both cultivated and wild species the outlook is altered. In the words of Bukasov [1936] the new potato species " open new horizons and present new problems. " Apart from the well-known difficulties

attending cross-fertilization due to partial or complete male sterility in numerous varieties of potato, many of the new species differ from the commercial potato in the number of their chromosomes. Again, the desirable characters in them *e.g.*, blight resistance, may be linked with undesirable characters such as very long stolons, deep eyes and fantastic colouring. In order to transfer the few desirable characters from these species to the commercial potato varieties while retaining the properties of the latter it may be necessary to repeatedly back-cross to the latter. This is possibly not so necessary with a cultivated species such as *S. andigenum* which approaches *S. tuberosum* in many of its characters and indeed possesses the same number of chromosomes; with species such as *S. demissum*, *S. Antipoviczii*, etc., however, back-crossing appears to be indispensable.

It has also been suggested that the methods employed in breeding maize in America, *i.e.* in breeding to eliminate deleterious recessive characters, followed by intercrossing of the best inbred strains may be applied to the potato [Robb, 1934].

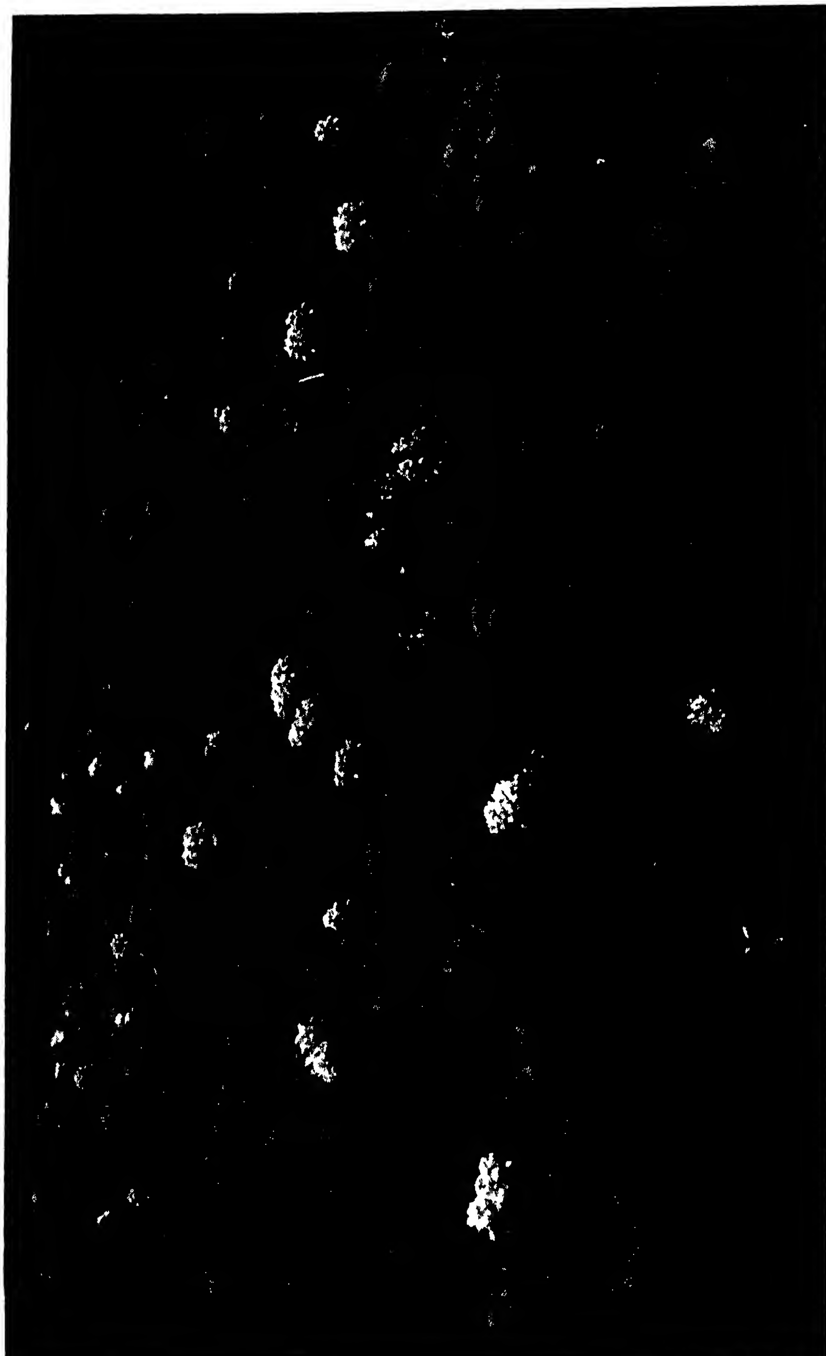
PART II

Present position of potato breeding in India

Little actual potato breeding has so far been carried out in India, the activities of the various Agricultural Departments having been mainly restricted to the testing of varieties imported from abroad. Occasionally attempt has been made to raise new varieties from seeds but apparently without much success.

Potato breeding in India was taken up in earnest when two potato schemes financed by the Imperial Council of Agricultural Research came into operation in 1934 and 1935 respectively. The Madras Potato Scheme has for its object the production of varieties suitable for local conditions. The Potato Breeding Scheme for Northern India has a comprehensive programme embracing the whole of Northern India and provides a Sub-station in the hills to work in co-operation with the Botanical Section of the Imperial Agricultural Research Institute.

In this connection it may be mentioned that as a rule potatoes rarely flower or form berries on the plains of India. For example, out of 122 cultures grown at Pusa in 1934-35 from samples of tubers received from different parts of India only thirteen stocks produced flowers and only three formed berries. One variety, at present called "Pusa White" for convenience, however, showed fairly high flower and berry production. A low temperature with high humidity is generally considered to be conducive to abundant berry production, conditions rarely fulfilled in the plains. In the hills, however, both flower and berry production are often satisfactory (Plates XXVI and XXVII). In this connection it may be mentioned that an experiment was carried out in the summer of 1935 to determine the most suitable site in the hills of North India for a potato breeding station. A standard set of about twenty varieties was grown at the following centres and



A potato field at Simla showing plants of the local variety in flower

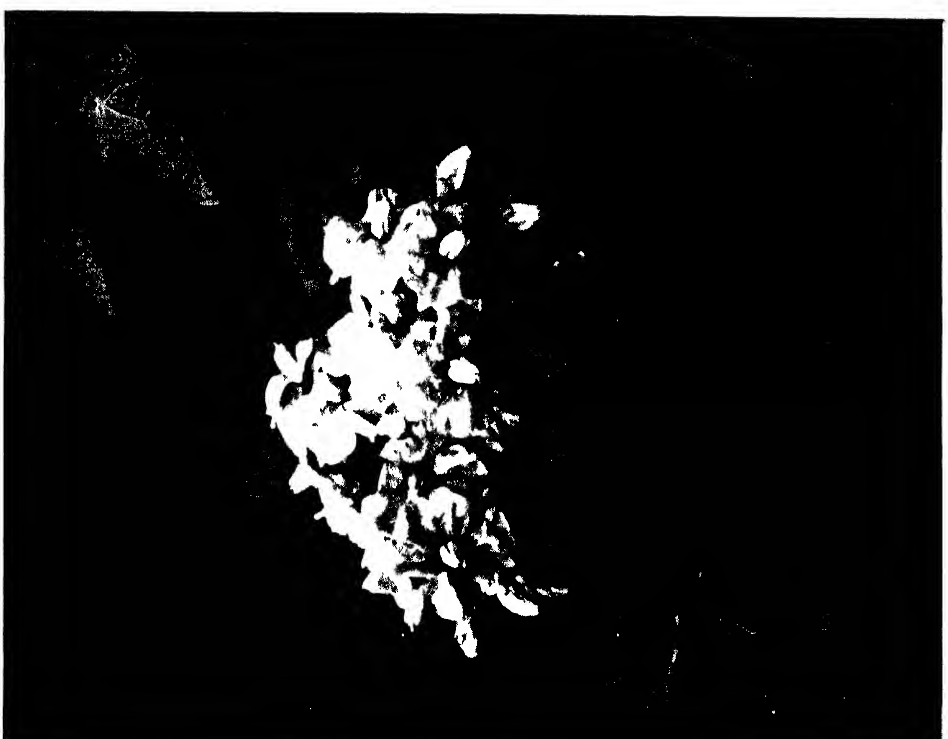


Fig. 2. Field cage

Fig. 1. Seedlings of S. *[illegible]* growing in a box

flower formation and fruit production studied, with the co-operation of the Directors of Agriculture of the Provinces concerned :—

Chaubattia (Ranikhet) and Khabrar (Ramgarh) in the United Provinces.

Simla, Murree and Kulu Valley in the Punjab.

Shillong in Assam.

Simla was ultimately selected as it combined satisfactory berry formation in most varieties, with other facilities desirable in a potato breeding station.

Raising plants from true seed—The main problems of potato growing in India have been discussed in a general way in a previous section. One of the immediate problems at Simla was to obtain true seeds, and to devise methods of germinating them and raising the plants to maturity.

Preliminary tests of germination in petri dishes were made in 1934 with seeds of India potato varieties and of the following species :—*S. acaule, S. andigenum, S. Antipoviczii, S. Caldassi, S. chacoense, S. Commersonii, S. demissum, S. Fendleri, S. Jamesii, S. Maglia, S. neoantipoviczii, S. otites* and *S. polyadenium*. All except those of *S. acaule* and some of the *andigenum* varieties germinated freely.

Dormancy of seed.—Potato seeds, at least in the case of some varieties, exhibit dormancy. Seeds sown at Pusa one to two months after harvest completely failed to germinate. With increasing length of time after harvest the percentage of seeds which germinated steadily increased. One-year-old seeds gave excellent results.

Chilling the seeds of Admiral, Coonoor White and Pusa White varieties for a week at 9-10°C. before placing in petri dishes for germination gave rather inconclusive results.

As soon as seedlings were large enough to handle* they were pricked out into flats filled with loamy soil (Plate XXVIII, Fig. 1) or directly into the ground. In some cases they were first set out in boxes and later on, after they had made some growth, transplanted in the ground.

An interesting feature was the appearance of weakly yellowish seedlings in fairly large numbers in the case of *S. demissum* and *S. neoantipoviczii*. Counts of normal and yellow seedlings in a number of boxes gave the following results :—

	No. of green seedlings	No. of yellow seedlings.	Total number of seedlings
S. demissum	193	61	254
S. neoantipoviczii	51	15	66

*Generally soon after the appearance of the first pair of foliage leaves.

The figures suggest monofactorial segregation. The yellow seedlings died soon after transplanting and were responsible for lowering the survival value of seedlings in *S. demissum* and *S. neoantipoviczii* to about 50 per cent as compared with over 75 per cent in the case of varieties of *S. tuberosum*.

The agricultural value of seedlings cannot be accurately assessed in the first year and it is necessary to protect the plants from infection by insect-conveyed virus diseases, which are common in India, particularly in the plains. The type of cage adopted at Pusa, consisting of a fine wire-mesh chamber with a glass roof and double doors, is illustrated in Plate XXIX. Over 200 boxes of a size 18″ × 12″ × 10″ can be accommodated in this. Small cages for use in the field are also illustrated. (Plate XXVIII, Fig. 2)

Some species and varieties require short-day conditions to produce tubers and, if planted in summer, may require special arrangements for curtailing daylight. A cover of heavy dark cloth slipped over the type of field-cage referred to in the previous paragraph was found to serve the purpose. By using this in the mornings and evenings it was possible to give short-day conditions to the potato plants requiring it.

Summary

The present position of potato breeding is briefly reviewed and reference is made to recent potato breeding work in Europe and America.

The problems of potato breeding in India are discussed. Among the most important are the raising of varieties resistant to the Early and Late Blights and to the various virus diseases. The problems of dormancy, frost, photoperiodism, etc., are also mentioned.

In conclusion, an account is given of the potato breeding experiments recently initiated in Northern India.

The writer is indebted to Dr. R. N. Salaman, F. R. S., for helpful criticism of the manuscript.

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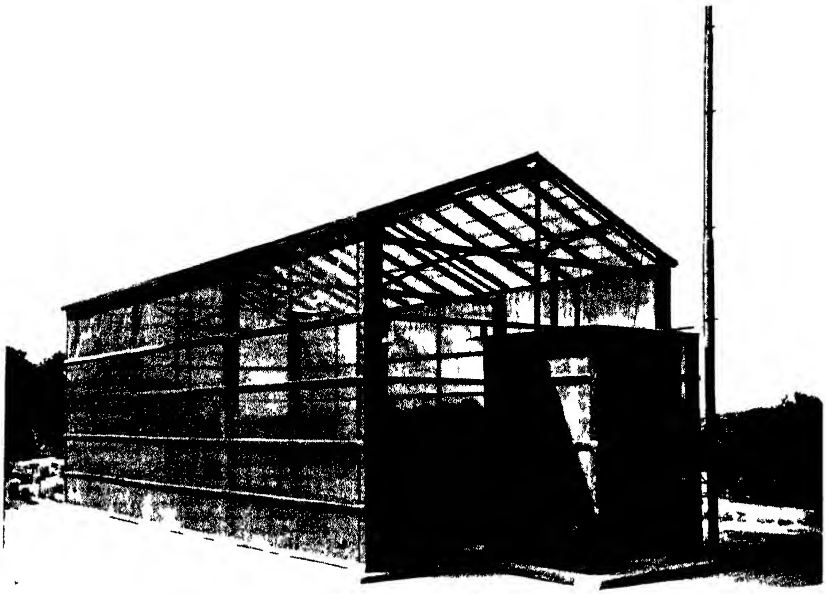

Fig. 1. Large cage: view of exterior

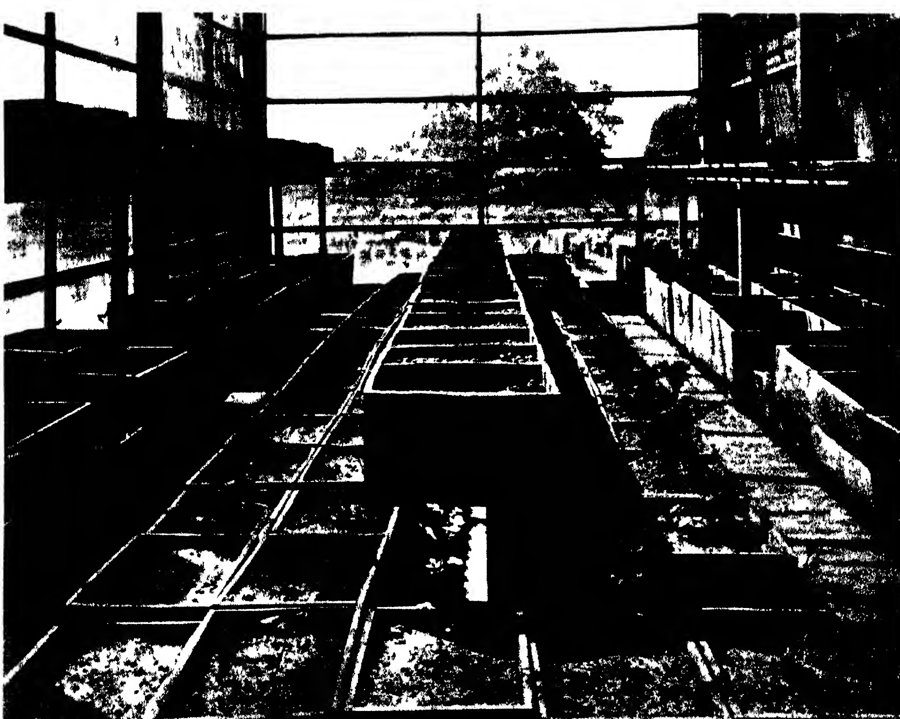

FIG. 1 A typical infestation of *kans*

FIG. 2 The green cover in place

BIOLOGICAL ERADICATION OF *KANS* (*SACCHARUM SPONTANEUM*) IN FIELD PATCHES

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PERENNIAL weeds such as *kans* (*Saccharum spontaneum*) in Central India often infest the cultivators' fields and are responsible for robbing the soil of its productivity, always to the detriment and sometimes to the extinction of crops (Plate XXX, Fig. 1.). The use of a special plough for the eradication of *kans* was reported by Batchelor [1906]. A method for the eradication of such weeds was also evolved at the Institute, involving the use of the '*kans* plough', an American ridging plough modified to suit the purpose [Howard and Howard, 1929]. Perennial weeds can also be more or less effectively eradicated by mechanical cultivation but it is difficult for the Indian ryot to use this method unless special facilities are created for him by others. Further, mechanical cultivation is usually done in dry weather and it is doubtful whether the viability of rhizomes can be completely destroyed by mere desiccation and heat; especially when some of the rhizomes are bound to be covered by the non-conducting earth and protected from such influences as prevail only above the surface. In practice it has been found that it is usually beyond the means of the Indian cultivator to use the *kans* plough. The success of the method depends upon timely interception of fresh growths from the *kans* rhizomes during the rainy season, before they are able to develop sufficiently to feed on the soil nutrients or to establish fresh rhizome development. This process has to be repeated until the food reserves in the rhizomes become depleted and they become incapable of putting forth new shoots. This demands systematic working otherwise it may even help the weed to spread to new areas. Hence when weeds infest large areas as in parts of the Central Provinces or Bundelkhand and become a general scourge leaving no scope for agricultural improvement by individual initiative, organized effort for their control by mechanical means is perhaps likely to be convenient and profitable, until such infestations are reduced to scattered growths. These are then likely to be neglected and allowed to persist just the

same way as *kans* patches are usually left untouched even in normal fields. The provision of a simple method within the reach of the individual cultivator seems to be the only way to get rid of patchy weed growths. Chemicals such as sodium chlorate, sodium arsenite and sulphuric acid have recently been employed for weed eradication ; but trials with these chemicals on *kans* at the Institute have not given satisfactory results and their application was laborious and costly. An industrious cultivator usually digs the weed out of the patches but this is done only when it is absolutely necessary, as for instance, in garden lands.

It was, however, observed that wherever rainwatered compost was made or weeds were heaped on field margins overgrown with grass, a complete eradication of all growths occurred [Jackson *et al*, 1934]. This could obviously be attributed to the adverse effect on the roots of grasses of the products of partially decomposed vegetable material permeating the upper soil zone, of the accumulation of carbon-dioxide and of the complete absence of light. Artificial mulches using such material as grass, straw, banana leaves and paper have elsewhere been found to suppress weeds and to exercise beneficial influences on the soil and crop. It therefore seemed possible to develop a simple method of weed eradication by the application of this principle.

As a preliminary study, the Institute fields, Nos. 27 and 28, usually water-logged and overgrown with a thick mantle of weeds during rains, were sown with *sann* (*crotalaria juncea*) in June 1934. About six weeks after sowing, the growths of *sann* and weeds were cut and laid flat as a cover on the soil with the aid of *bakhar* (local blade harrow). The cover was left untouched up to the end of the rains when for the most part it had decayed. There was practically no weed growth left standing and the soil regained tilth earlier than that of other similar fields not so treated. This was encouraging.

At the beginning of the rains in 1935, six patches of dense *kans* growths were selected in the Institute fields, Nos. 3, 30 and 31—the first two being cultivated fields and the third one a grass area. Half of the patches in 30 and 31 were covered with wheat *bhusa* (chaffed straw) to about one foot thickness, and the other half with green grasses and weeds, including *kans*, to about the same thickness but applied in successive layers of four inches each layer being compacted by trampling. In field No. 3 the *kans* patches were covered in the same way by green *sann* (Plate XXX, Fig. 2). All *kans* growth was cut down before making the covers. These were twice remade with fresh additions wherever necessary due to rotting and shrinkage. Any *kans* shoots appearing at the time of remaking the covers were cut back. The first cover was made on July 20th and was renewed twice, first after twenty days and then twenty-five days later. At the time of the first renewal what was originally a dense *kans* growth was already reduced to a few shoots. After the second renewal a further reduction occurred, leaving only a few miniature shoots struggling through the cover with scant success. The ground below the covers was in a sodden condition.

When the covers were finally removed at the end of the rains, in the beginning of October, the *kans* appeared to have become extinct everywhere. The patches covered with wheat *bhusa*, however, showed an appreciable number of yellowish shoots three to four inches in height and the rhizomes were not decomposed. In contrast with this, whatever *kans* shoots existed under the green cover were in a rotting condition and so were all the rhizomes. Stray shoots and rhizomes near the borders of the covers showed some life and were trying to emerge from the cover by bending sideways. This indicated that green material is more effective than dry residues and that covers should extend to a sufficient distance beyond the borders of *kans* patches to prevent the survival of the marginal shoots.

The *kans* patches so treated in fields No. 30 and 3 were, along with the remaining portions, given the usual post-rain preparatory tillage and sown with wheat in October 1935. By December there was apparently no difference between its growth on the *kans* patch and the rest of the field and there was no fresh growth of *kans*. In the grass area, however, a few shoots began to appear, though insignificant compared with the original growth. On the treated patches in cultivated fields, however, *kans* growth failed to reappear up to December 1937. Hence there seems to be a considerable likelihood that perennial weeds can be exterminated in one season by a suitable application of this principle, both in the cultivated fields and grazing lands. At the most the treatment may have to be repeated a second season.

It is evident that a technique on these lines with suitable local modifications will be very useful and well within the cultivator's means, at any rate for all rain-fed tracts, and perhaps even in arid areas under irrigation, in seasons when the rainfall is fairly high. In arable land *kans* growth begins in small isolated patches which are difficult to deal with by bullock-drawn implements and hand-digging is still more laborious and costly. These small patches are obviously very suitable for treatment by the method described.

It is not necessary to grow green material specially for this purpose. It will suffice if the material collected during the usual weeding operations is simply dumped on *kans* patches. No extra cost or labour will thus be required as would occur if green material is specially grown, cut, used as cover and is removed twice as in the test described. Systematic covering of the patches while dumping the weeds and a little trampling will, of course, be necessary for complete eradication in one season. Even when the cultivator cannot afford to take this extra care, most of the weeds in the patches in his field will probably be killed if he only dumps his weedings on top of them.

This application of a common natural process seems so far to have escaped attention but it is apparent that it will be a valuable addition to the cultivator's armaments in his struggle with other forces of nature.

The method has the further advantage that in the very act of weed eradication humus is applied to the soil to compensate for the exhaustion, if any, it had suffered by the weed growth.

EFFECT ON THE SUBSEQUENT CROP

An apparent gain in fertility was shown by the behaviour of the following wheat crop. After December the crop in the *kans*-freed patches was darker, green and taller than the surrounding growth and it ripened earlier by about 15 days.

Twelve pairs of plots (10′ × 7½′) were harvested in the last week of March 1936, each pair consisting of one plot in a *kans*-freed patch treated with green material and the other in an adjacent portion of the field where there was neither *kans* growth nor treatment given.

A ten-feet strip between the adjacent sides of the plots to be compared was excluded as non-experimental. One of the adjacent flanks of the patches was chosen at random for locating the control plot separately for each pair. The yields of both grain and *bhusa* were significantly raised by the treatment.

TABLE I (*a*)

Increased fertility due to biological weed eradication. Yields of wheat (local durum-type) in lbs. per acre

	Green cover	No cover	Significant difference on five per cent level
Grain	811	427	134
Straw	908	672	186
Straw/grain*	1·20	1·64	..

*The figures are average of ratios obtained for individual plots

Analyses of variance

Wheat—grain. Unit—ounce

Due to	D. F.	Sum of squares	Mean square (M. S.)	½ log$_e$ (M. S.)	Z
Blocks . . .	11	266·46	24·22	1·5936	0·1838
Treatments . .	1	672·04	672·0	3·2552	1·8454**
Error . . .	11	184·46	16·77	1·4098	
Total .	23	1122·96			

**Shows the significance on one per cent level (on this and other pages too).

Wheat—straw

Due to	D. F.	Sum of squares	Mean square (M. S.)	$\frac{1}{2}$ $\log_e$ (M. S.)	Z
Blocks . . .	11	300·50	27·32	..	Negative
Treatments . .	1	253·50	253·5	2·7677	1·0284*
Error . . .	11	356·50	32·41	1·7393	
Total .	23	910·50			

Ratio—straw/grain

Due to	D. F.	Sum of squares	Mean square (M. S.)	$\frac{1}{2}$ $\log_e$ (M. S.)	Z
Blocks . . .	11	1·9923	0·1811	..	Negative
Treatments . .	1	1·1704	1·170	$0-\bar{1}$·0785	0·6828
Error . . .	11	3·2851	0·2986	1·3957	
Total .	23	6·4478			

*Shows the significance on five per cent level (on this and other pages too).

Cotton was grown only in field No. 3 following wheat. Its growth on the treated patches was conspicuous from the beginning. On the 6th of October 1936 observations on cotton were taken on the same plots on which they were taken for wheat in the previous year.

The number of plants, average height of six random plants and the total number of developing bolls per plot were recorded. These with their statistical evaluation are included in Table I (*b*).

TABLE I (*b*)

Effect on the cotton crop grown in 1936

Observations : 105 days after sowing

(*a*) For six random plants	Green cover	No cover	Significant difference on five per cent level
Average height of plants in inches .	39·5	30·7	4·1
(*b*) For ten plots of a total area 750 sq. ft.			
Stand	571	430	..
No. of developing bolls . . .	3,603	1,771	1,000

Analysis of variance—Average height of plants, (Unit-inch)

Due to	D. F.	Sum of squares	Mean square (M. S.)	½ $\log_e \left[\frac{M.S.}{10}\right]$	Z
Blocks . . .	9	325·80	36·20	0·6433	0·3920
Treatments . .	1	387·20	387·2	1·8282	1·5769**
Error . . .	9	148·80	16·53	0·2513	
Total .	19	861·80			

Stand

Due to	D. F.	Sum of squares	Mean Square (M. S.)	½ $\log \left[\frac{M.S.}{100}\right]$	Z
Blocks . . .	9	7605·45	845·1	1·0672	0·5300
Treatments . .	1	994·05	994·1	1·1484	0·6112
Error . . .	9	2635·45	292·8	0·5372	
Total .	19	11234·95			

Number of developing bolls

Due to	D. F.	Sum of squares	Mean square (M. S.)	½ $\log_e \left[\frac{M.S.}{1000}\right]$	Z
Blocks . . .	9	110953	12328	1·2560	0·1160
Treatments . .	1	167811	167811	2·5614	1·4214**
Error . . .	9	87986	9776	1·1400	
Total .	19	366750			

The stand on the treated patches though numerically greater did not significantly differ from that on the untreated ones. The treated patches, however, grew a taller crop and produced a greater number of bolls per plant. The final yields, total as well as for two pickings of seed cotton from the treated patches were also higher than those of the controls as will be seen from table I (c).

Table I (*c*)

Influence of biological weed-eradication

Yields of seed cotton-lbs. per acre

Yield from	Green cover	No green cover	Significant difference on five per cent level
			0
Three pickings (total)	818·8	339·5	271·
First picking	326·9	109·0	171·
Second picking	410·2	138·8	174·
Third picking	81·7	91·7	..

Analysis of variance (Unit—½ oz.)

(Three pickings total)

Variance due to	D. F.	Sum of squares	Mean square (M. S.)	½ log (M. S.)	Z
Blocks . . .	9	9125·2	1013·9	3·4607	0·0768
Treatments . .	1	13939·2	13939·2	4·7713	1·3874**
Error . . .	9	7824·8	869·4	3·3839	..
Total .	19	30889·2			

First picking

Variance due to	D. F.	Sum of squares	Mean square (M. S.)	½ log $\left[\frac{\text{M. S.}}{100}\right]$	Z
Blocks . . .	9	2013	223·7	0·4029	..
Treatments . .	1	2880	2880	1·6802	1·2772**
Error . . .	9	2015	223·9	0·4030	..
Total .	19	6908			

Second picking

Variance due to	D. F.	Sum of squares	Mean square (M. S.)	$\frac{1}{2}\log_e\left[\frac{M.\ S.}{100}\right]$	Z
Blocks	9	2970·2	330·0	..	Negative
Treatments	1	4470·0	4470·0	4·2026	1·2590**
Error	9	3243·5	360·4	2·9436	
Total	19	10683·7			

Third picking

Variance due to	D. F.	Sum of squares	Mean square (M. S.)	$\frac{1}{2}\log_e$ (M. S.)	Z
Blocks	9	152·5	16·9	..	Negative
Treatments	1	6·1	6·1	..	Negative
Error	9	162·4	18·0	..	
Total	19	321·0			

The increased fertility thus seems to have persisted in the second year., This is however, only to be expected from the results ordinarily obtained when soil-humus is increased. The eradication of the weed and increased fertility in *kans* patches occurring in the manner described above is simply a practical illustration of the inevitable working of the two universally observed natural phenomena—(1) The impossibility of plant life surviving in anærobic media produced by rotting vegetable matter and (2) the increase in productivity following the application of humus to soils. Being so, it is expected that the Indore results are very likely to be obtained elsewhere by the same or a suitably modified technique capable of producing similar soil conditions.

In addition to increased yields, the wheat grain produced from the treated patches appeared distinctly superior to that from the untreated ones. It resembled the well-known *ekdania* variety in Central India—bold, horny and translucent—in appearance, though ordinary local Durum type was sown. That from the untreated plots was smaller with yellowish, opaque blotches and generally a chalky fracture.

On analysis of the average samples the following results were obtained (Tables II and II (*a*).

TABLE II

Influence of biological weed-eradication, on the development and composition of wheat grown subsequently. Physical observations

Wheat grain	Weight of 500 seeds (in grms.)	Volume of 500 seeds (in c. c.)	Per cent undeveloped seed	Moisture
(1) from control plots . .	26·0	32·3	20·0	4·36
(2) from the treated plots .	27·2	32·8	14·0	4·95
(3) of *ekdania* variety from Runglia, Dhar State .	29·1	34·5	14·0	4·54

TABLE II (*a*)

Chemical composition (percentage on oven-dry basis)

Total N	Albuminoid N	Ash	Crude fibre	Ether extract	Gluten	Starch	Crude proteins	Albuminoids
1·65	0·82	1·51	1·60	2·12	8·04	49·23	10·31	5·13
2·07	1·13	1·33	1·66	2·15	11·53	31·79	12·94	7·06
2·08	1·79	1·35	1·13	1·54	7·51	45·52	13·00	11·19

The superior quality of the grain produced in the *kans*-freed patches is clearly shown.

One-inch core samples of soil were taken up to a depth of fifteen inches at one random point in each plot. Eye-inspection of the cores showed two distinct horizons, zero to six inches and six to 15 inches. Each core was accordingly separated into two such portions. Soil of the same zones from plots, in the same portion of the fields was pooled together to make one composite sample for that portion of the fields. These were examined for their contents of organic matter by Robinson, McLean and Williams method. The results are given in Table III.

TABLE III

Increase in organic matter content of soils due to biological weed-eradication

Organic matter = Carbon-content × *1·724*

Description	Horizon 0″-6″	Horizon 6″-15″
(*Soil from field No.* **3**)—		
„ untreated	0·60	0·63
sann-treated	0·71	0·56
„ untreated	0·69	0·81
sann-treated	0·86	0·80
(*Soil from field No.* **30**)-		
„ Untreated	0·68	0·66
„ Treated (green weeds)	0·89	0·77
„ Untreated	0·69	0·71
„ Treated (*bhusa*)	0·90	0·69

The treated patches apparently showed a higher content of organic matter in the upper zones of their soils than that of the corresponding control and the better quality of grain obtained may be due to consequent changes in soil characteristics. In order to verify this, further examination is being made of these soils and of those from *kans* patches where the weed has not been biologically eradicated and where crops cannot be successfully grown. It is hoped thus to separately assess the effect of *kans* growth itself on the soil as well as estimate the influence of the treatment. These results will be presented in a further communication. The differences in wheat-quality due to changes in environment including soil condition have been recorded by many workers (Wheat Studies 1934).

It has been found practicable to eradicate perennial weeds by applying to the land a monsoon cover of green material allowed to decay *in situ*. The weed-infested soil appeared to have become more productive than the surrounding area, being enriched with organic matter, and the quality of wheat grain grown upon it was also superior.

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A STUDY OF SURTI BUFFALOES REARED AT THE POONA AGRICULTURAL COLLEGE DAIRY

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In India, the buffalo supplies the bulk of the milk and milk products such as butter (both for table use and cooking purposes), ghee, *khoa* (dessicated milk), curd, buttermilk, etc., and accordingly is the main dairy animal of the country. One of the most important problems for a dairyman, either in business for the production and disposal of milk or as a breeder with a view to establish an economic type of dairy animal for the country, is to maintain a steady and regular supply of milk economically.

In order to achieve this object the following are the initial problems which require to be investigated :—

(1) Distribution of calvings in different months.

(2) Lactation period and dry period in different calvings.

(3) Distribution of milk yield in different lactations month by month.

(4) Persistency in lactation yield month by month.

With a view to study these problems, the records of farm-bred buffaloes of the Surti breed have been examined in detail by the writer at the Agricultural College Dairy, Poona, where this breed is systematically reared and maintained. Animals that had aborted or given birth to a premature calf and those that were purchased from outside have not been taken into consideration. Under usual conditions, the animals are fed with green fodder at milk-stage (throughout the year) *viz.*, maize, *nilwa*, oats and peas, lucerne and guinea grass, supplemented with small quantities of chaffed *kadabi*. Neither grass, hay nor any grazing is given to the herd. The concentrates fed mainly consist of a mixture of wheat-bran, groundnut cake, crushed *kulthi* (*Dolichos biflorus*) and cotton seed, with two ozs. of common salt per head per day, at the rate of 4·5 to 5 lbs. of above mixture for every 10 lbs. of milk produced.

The procedure adopted in the study was to record separately the monthly milk yield of buffaloes in different lactations, together with the dates of calving and dates of going dry in order to work out the following data :—

(1) Actual number of days a buffalo was in milk during the first month of her lactation (as it is generally a broken month).

(2) Actual milk yield in each month.

(3) Number of days in milk and dry in each calving period.

I. Distribution of calving of Surti buffaloes in different months

The total number of cases examined in the above study was 335.

TABLE I

Showing distribution of calvings of Surti buffaloes in different months in the year

Month	Number of calvings	Percentage of calvings
January	16	4·77
February	6	1·79
March	8	2·39
April	4	1·20
May	9	2·69
June	8	2·39
July	19	5·67
August	55	16·41
September	69	20·60
October	65	19·40
November	44	13·14
December	32	9·55
Total	335	100·00

The above table shows that (1) there is a particular period, *viz.*, August to November, when about 70 per cent of buffaloes calve as a result of which there

is a large production of milk up to January and thereafter the milk supply goes down gradually till the next calving season commences, (2) the maximum number of calvings is in September *i.e.*, about 21 per cent—and the minimum *i.e.*, 1·2 per cent, in April.

The data, when further examined with respect to first calvings only, give very interesting information, showing the natural tendency towards calvings—even in the case of first calvers—as shown below :—

TABLE II

Showing the distribution of first calving among Surti buffaloes in different months in the year

Month of calving	Number of calvings	Percentage distribution	
January	4	4·76	
February	3	3·57	
March	3	3·57	
April	..	..	
May	..	..	
June	..	..	
July	..	..	
August	13	15·48	83·34
September	29	34·52	
October	18	21·43	
November	10	11·91	
December	4	4·76	
Total .	84	100·00	

It appears from the above table that (1) the first calvings are mainly concentrated from August to November to the extent of about 83 per cent and the remaining 17 per cent is distributed from December to March, (2) there were no first calvings from April to July and (3) the maximum number of first calvings *i.e.*, 34·5 per cent, falls in the month of September.

Fig. 1 shows the percentage distribution of calvings in different months of the year.

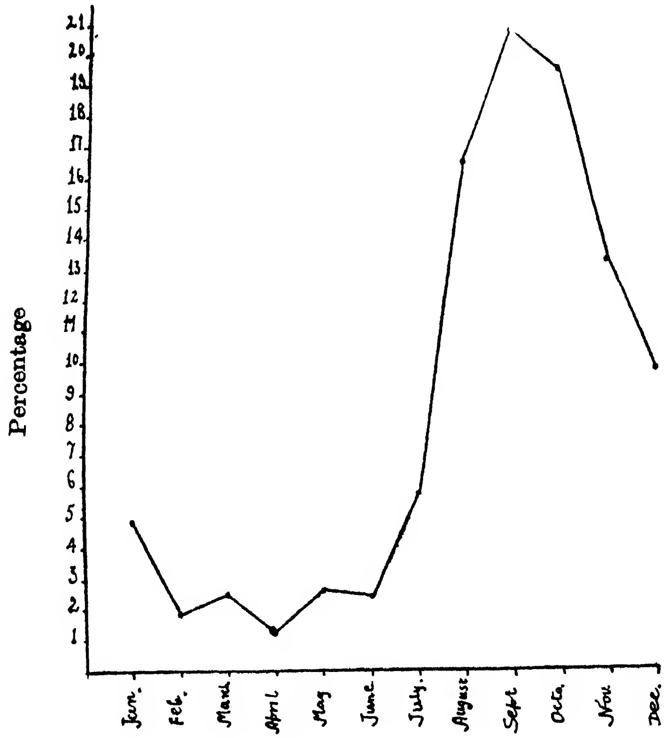


FIG. 1. Showing percentage distribution of calvings in Surti breed of buffaloes

II. Lactation period and dry period among Surti buffaloes in different calvings

(*a*) *Lactation period*.—There were 335 buffaloes for the study of the distribution of calvings as given under Table I, but in some of these all data regarding the lactation-length, dry period and lactation yield were not complete ; thus

rejecting the animals whose data were incomplete, there remained 218 buffaloes under the study of lactation period and dry period as given below :—

TABLE III

Showing the mean standard deviations and coefficient of variation of lactation-length among Surti buffaloes in different lactations

Number of lactation	Number of cases	Mean lactation length in days	Standard deviation	Coefficient of variation
1st	72	383·7	134·1	34·9
2nd	47	357·7	90·9	25·4
3rd	33	338·6	67·8	20·0
4th	24	317·4	68·7	21·6
5th	15	321·0	87·6	27·2
6th	11	301·2	59·1	19·6
7th to 10th	16	311·2	45·9	14·7
Total .	218	..	..	..
Average .		350·1	80·1	22·8

Table III indicates that (1) the average lactation length is 350 days in Surti buffaloes, (2) the first lactation is the longest of all, *viz.*, 383 days, (3) the lactation length gradually decreases from first lactation onwards, and (4) on an average no mature animal remains in milk for more than thirteen months.

(*b*) *Dry period.*—There were 218 buffaloes (*i.e.*, the same animals as studied under lactation period) for the study of dry period as given below :—

TABLE IV

Showing the mean standard deviations and coefficient of variation of dry period among Surti buffaloes in different lactations

Number of lactation	Number of cases	Mean dry period in days	Standard deviation	Coefficient of variation
1st	72	118·9	75·6	63·6
2nd	47	118·7	50·3	42·4
3rd	33	108·6	57·0	52·4
4th	24	101·2	49·8	49·2
5th	15	105·0	28·8	27·4
6th	11	99·6	36·9	37·0
7th to 10th	16	86·2	51·6	59·8
Total .	218	..	..	..
Average .	..	111·0	60·3	54·3

It appears from Table IV that (1) the average length of dry period is 111 days in Surti buffaloes, (2) on an average no mature animal remains dry for more than four months and (3) the dry period gradually decreases as the animal advances in lactation.

The following table gives a consolidated review of the lactation period and dry period of Surti buffaloes in different lactations.

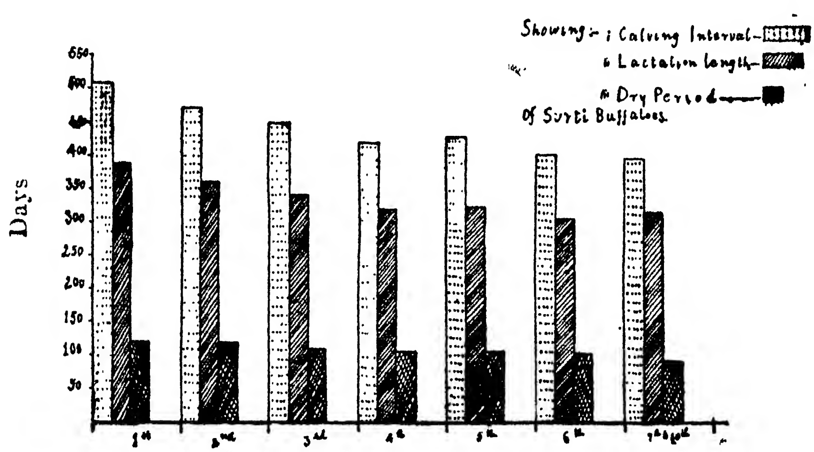
TABLE V

Showing the length of lactation and dry period among Surti buffaloes in different lactations

Number of lactation	Number of cases	Mean lactation length in days	Mean dry period in days	Interval between two calvings in days
1st	72	383·7	118·9	502·6
2nd	47	357·7	118·7	476·4
3rd	33	338·6	108·6	447·2
4th	24	317·4	101·2	418·6
5th	15	321·0	105·0	426·0
6th	11	301·2	99·6	400·8
7th to 10th	16	311·2	86·2	397·4
Total	218	..	..	..
Average	..	350·1	111·0	461·1

Table V shows that the interval between two calvings works out to 461 days in Surti buffaloes—350 days in milk and 111 days dry—or in other words a Surti buffalo, on an average, conceives 148 days after calving (461 days interval between two calvings *minus* 313 days as gestation period).

Fig. 2 shows the graphical review of lactation length and dry period of Surti buffaloes during different calvings.



Lactations

FIG. 2. Showing calving interval, lactation length and dry period of Surti buffaloes

III. DISTRIBUTION OF MILK YIELD IN DIFFERENT LACTATIONS MONTH BY MONTH

There were 218 cases under study from one to ten lactations. Table VI gives the average monthly milk yield of Surti buffaloes till the completion of drying of all cases in each lactation.

TABLE VI

Showing the average monthly milk yield of Surti buffaloes in different lactations

Month	1st lactation		2nd lactation		3rd lactation		4th lactation		5th lactation		6th lactation		7th to 10th lactation in one group	
	Average milk yield lbs.	Number of cases	Average milk yield lbs.	Number of cases	Average milk yield lbs	Number of cases	Average milk yield lbs	Number of cases	Average milk yield lbs.	Number of cases	Average milk yield lbs.	Number of cases	Average milk yield lbs.	Number of cases
	in(18·2)		in(15·8)		in(17·9)		in (14)		in (17·2)		in (12·9)		in(16·8)	
1st	190 days	72	217 days	47	305 days	33	234 days	24	288 days	15	216 days	11	267 days	16
2nd . .	422	72	564	47	615	33	614	24	651	15	646	11	589	16
3rd . .	433	72	552	47	600	33	639	24	629	15	656	11	593	16
4th . .	409	72	512	47	564	33	576	24	580	15	620	11	555	16
5th	393	72	479	47	524	33	540	24	538	15	537	11	509	16
6th . .	372	72	448	47	474	33	488	24	512	15	524	11	473	16
7th .	350	72	406	47	435	33	434	24	464	15	451	11	447	16
8th . .	322	71	345	47	379	33	376	24	411	15	407	11	401	16
9th . .	274	70	317	44	331	32	303	24	353	14	396	10	345	16
10th .	246	62	280	40	267	31	274	19	247	13	275	10	212	16
11th .	217	50	223	37	191	27	225	15	209	9	266	7	189	8
12th .	218	38	195	31	158	17	165	10	217	5	171	5	141	5
13th	208	31	209	22	123	11	128	5	103	4	177	2	186	2
14th	178	28	180	19	220	4	183	3	263	1	277	1	96	2
15th	178	23	137	15	167	4	154	3	211	1	206	1	8	2
16th	173	21	165	8	124	4	59	3	199	1	83	1		
17th	149	21	118	6	75	2	21	1	170	1				
18th .	137	17	174	8	89	1			150	1				
19th .	101	15	93	2					164	1				
20th .	120	10	10	1					132	1				
21st	104	7							5	1				
22nd	66	5												
23rd	100	2												
24th .	18	1												
Total	5378		5624		5591		5418		6496		5908		5011	

Table VI shows that (1) irrespective of the number of lactations, there is a general tendency towards decline in milk yield as the lactation period advances, in spite of the fact that the number of animals in milk remains almost constant during first eight to nine months of the lactation and (2) the fifth lactation shows the highest yield.

Table V indicates what the mean lactation period of a Surti buffalo is likely to be during different lactations. Table VII is based on these periods in order to show the average milk-yielding capacity of a Surti buffalo in different lactations.

TABLE VII

Showing the mean lactation yield, lactation length, dry period and annual average yield of Surti buffaloes in different lactations

Number of lactation	Lactation yield in lbs.	Number of cases	Mean lactation length in days	Mean dry period in days	Total interval between two calvings in days	Annual average yield in lbs. (based on calving interval)
1st . . .	4054	72	383·7	118·9	502·6	2944
2nd . . .	4589	47	357·7	118·7	476·4	3516
3rd . . .	4772	33	338·6	108·6	447·2	3895
4th . . .	4703	24	317·4	101·2	418·6	4101
5th . . .	4882	15	321·0	105·0	426·0	4183
6th . . .	4857	11	301·2	99·6	400·8	4423
7th to 10th .	4521	16	311·2	86·2	397·4	4152
Total .	..	218	..	..	..	..
Mean .	4609	..	350·1	111·0	461·1	3887

Table VII shows that (1) the yield is gradually increasing from first lactation onwards reaching the maximum, *viz.*, 4882 lbs. in the 5th lactation, (2) the mean lactation yield works out at 4609 lbs. with 461 days as interval between two calvings (350 days in milk and 111 days dry) and (3) the average annual yield (based on milking and dry period combined) works out at 3887 lbs.

Fig. 3 gives a graphical representation of the lacation yield.

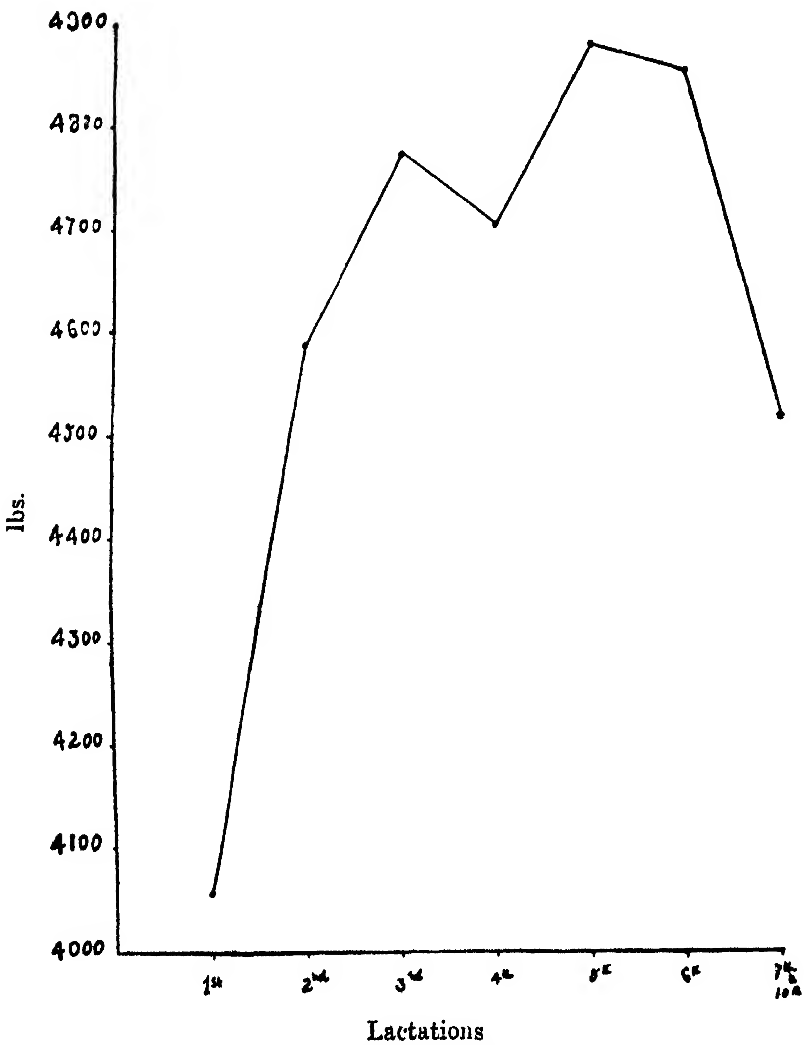


FIG. 3. Showing lactation yield of Surti buffaloes

IV. PERSISTENCY IN LACTATION YIELD MONTH BY MONTH

In the study of persistency of milk-yield the first month of calving, which is usually a broken month, has been omitted; moreover the yield in the first month

is also irregular. The persistency is therefore worked out from 2nd to 3rd month, 3rd to 4th month and so on till the 11th month of lactation, as after that period most of the animals dry off and the population becomes very small.

Table VIII shows month to month decline in milk yield (in percentage) in different lactations.

TABLE VIII

Showing month-to-month decline in milk-yield in different lactactions of Surti buffaloes (in percentage)

Month	1st lactation	2nd lactation	3rd lactation	4th lactation	5th lactation	6th lactation	7th to 10th lactation	Average decline per 100 lbs. *
2nd to 3rd . .	+2·6	2·1	2·4	+4·1	3·4	+1·6	+0·7	+0·15
3rd to 4th . .	5·5	7·2	6·0	9·9	7·8	5·5	6·4	6·81
4th to 5th . .	3·9	6·4	7·0	6·2	7·2	13·4	8·3	6·52
5th to 6th . .	5·3	6·4	9·5	9·6	4·8	2·4	7·1	6·78
6th to 7th . .	5·9	9·3	8·2	11·1	9·4	13·9	5·5	8·38
7th to 8th . .	8·0	15·0	12·9	13·4	11·4	9·8	10·3	11·39
8th to 9th . .	14·9	8·0	12·7	19·4	14·1	2·7	13·9	12·84
9th to 10th . .	10·2	11·6	19·3	9·6	30·0	30·6	38·5	17·32
10th to 11th .	11·7	20·3	28·4	17·9	15·4	3·3	10·8	16·70
Average decline .	7·63	10·05	12·07	11·74	12·21	10·48	12·47	10·23

It appears from Table VIII that (1) the decline per 100 lbs. is almost constant for first six months, after which the effect of pregnancy is felt on the milk yield, which is indicated by a sharp drop, (2) the first lactation shows the minimum decline, *viz.*, 7·63 per cent, (3) the decline in the remaining lactations remains almost uniform *i.e.*, 10·05 to 12·47 per cent and (4) the average monthly decline of all lactations combined works out at 10·23 per cent.

**Vide* reference Kartha [1934]

Figs. 4 and 5 show the rates of decline in milk yield.

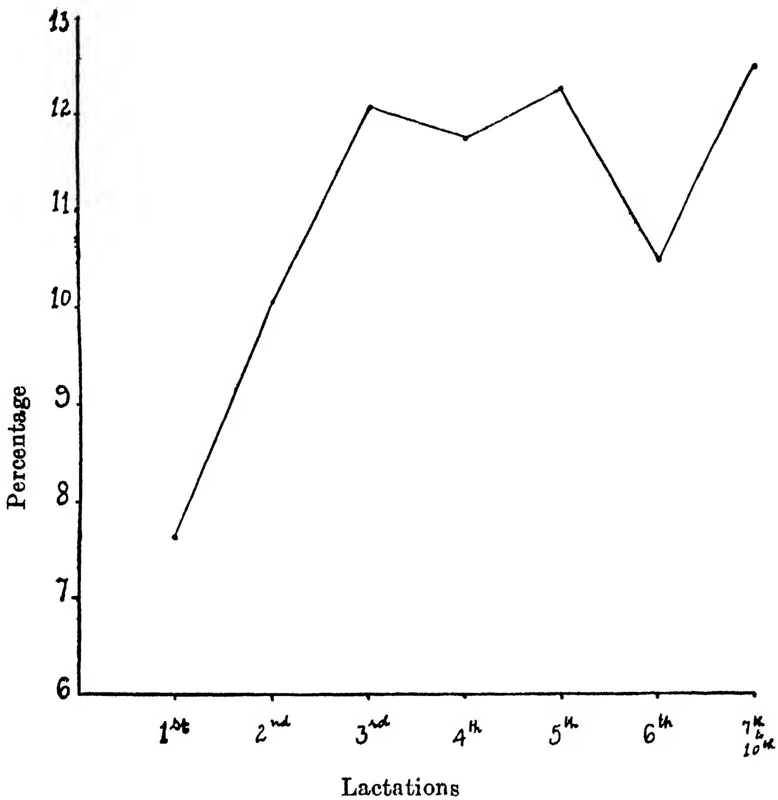


FIG. 4. Showing the rate of decline in milk yield of Surti buffaloes in different lactations (in percentage)

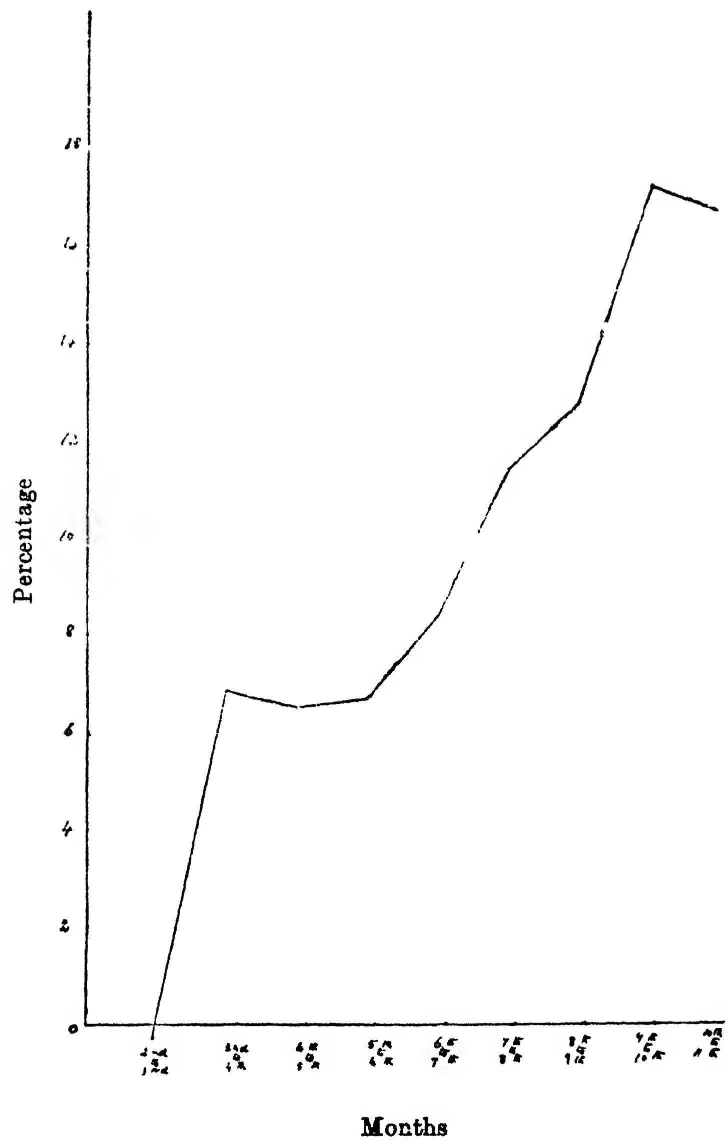


Fig. 5. Showing month-to-month decline in milk yield of Surti buffaloes (of all lactations combined) (in percentage)

SUMMARY

(1) About 70 per cent of Surti buffaloes calve between August and November, the least number of calvings taking place in the month of April.

(2) Eighty-three per cent of first calvings occur between August and November—there being no first calvings from April to July.

(3) On an average, a Surti buffalo lactates for 350 days and then remains dry for 111 days, thus the interval between two calvings works out at 461 days.

(4) The first lactation of a Surti buffalo is the longest, *viz.*, 383 days and the sixth is the shortest, *viz.*, 301 days.

(5) The number of animals in milk remains almost constant during the first eight to nine months of a lactation.

(6) Average lactation yield of a Surti buffalo works out at about 4,600 lbs. with 461 days (350 days in milk and 111 days dry) as mean interval between two calvings.

(7) The annual average yield of a Surti buffalo is about 3,900 lbs.

(8) The average monthly decline in the milk yield of Surti buffaloes works out at about 10 23 per cent. The first lactation shows the minimum decline, *viz.*, 7·63 per cent.

REFERENCE

Kartha, K. P. R. (1934). *Ind. J. Vet. Sci. & Anim. Husb.* **4**, 36-62.

THE CHEMICAL COMPOSITION OF 'BUTTERMILK'

BY

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AND

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THE term 'buttermilk', as it is commonly used in South India, refers to one of the following three products: (1) Whole milk, boiled, soured for about twelve to twenty-four hours. The fat is removed as far as possible by home-churning and the milk is diluted to suit individual tastes and needs. In some homes it is not the practice to remove fat. Undiluted soured milk from which the fat has or has not been removed is usually called 'curds'. (2) Whole milk, rid of all its cream, either soured or not. This is in fact what is usually known as skimmed or separated milk. (3) The washings obtained during the process of manufacture of butter from cream, carried out in dairies. By far the commonest form of so-called 'buttermilk' in India is that described under (1); the other two are available only in small amounts in localities in which creameries and dairies are situated. The problem of the nutritive value of 'buttermilk' and the real meaning to be attached to the term has proved troublesome in educational work, in carrying out diet surveys, and in adjusting institutional diets. The purpose of the present work was to investigate the chemical composition of a few samples of by-products of milk, obtained in the process of the manufacture of butter by the indigenous or churn method, which are generally known by the name 'buttermilk'. In North India the terms '*lassi*' and '*chass*' may be used. Attention has also been given to the use of the term 'buttermilk'.

EXPERIMENTAL

A large sample of fresh cow's milk was obtained from the Imperial Dairy Institute Milk Depot at Wellington. It was boiled for a few minutes and allowed to cool to about 40°C. when a small amount of local buttermilk of good quality (type 1) was added to it, in the proportion of roughly an ounce to a litre. The latter, though not a pure culture of *B. acidophilus*, was the inoculum for the souring of the milk. The mixture was put in a fermentation flask, which was shaken well, and a representative sample taken for analysis. Moisture, specific

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gravity, titrable acidity, *p*H (determined colorimetrically), mineral matter, fats (as ether extractives), crude protein, protein nitrogen, non-protein nitrogen, carbohydrates (by difference), calcium, phosphorus and iron were determined. Fermentation was allowed to proceed at room temperature, which ranged at the time of the experiment between 18° and 21°C. Representative sample were taken as far as possible, diluted to definite proportions, and then analysed. Dilution was carried to an extent corresponding with the practice followed in homes in various sections of the population ; in poor homes considerable quantities of water are added.

Analyses of skimmed or separated milk, sometimes known as ' buttermilk ' were not carried out since data already exist regarding the composition of such milk.

Two samples of ' buttermilk ' of type (3) were analysed, one sample representing the washings during the manufacture of butter from cream supplied by a contractor to a neighbouring dairy (sample 1) the other sample (2) being washings obtained from cream made in the dairy itself. The cream was diluted with water, kept at room temperature for about twenty-four to forty-eight hours, and then churned. The fat that separates was removed. The fluid left over represents ' buttermilk '.

In addition, ' buttermilk ' was prepared from comparable samples of cow's milk obtained from the same dairy, fermented with pure cultures of *B. Acidophilus*. Three flasks containing 500 c.cs. of boiled milk were, on cooling, each inoculated with 10 c.cs. of *B. acidophilus* culture and allowed to ferment under aseptic conditions in an incubator maintained at 37°C. The contents of the flasks were analysed after eighteen, twenty-four and forty-two hours of fermentation after partial removal of fat. Simultaneously two more flasks containing a similar quantity of milk were allowed to ferment with an equivalent amount of a mixed and impure culture of *B. acidophilus*, in a manner simulating the practice followed in Indian homes. The contents of the flasks were analysed after eighteen and twenty-four hours of fermentation after partial removal of fat. These experiments were carried out to find out whether any differences in chemical composition could be detected as a result of fermentation with pure and with mixed culture of *B. acidophilus*.

The results of the analyses of the different samples, are set out in Tables I and II.

TABLE I.

The chemical composition of "buttermilk"

	Moisture per cent	Total solids per cent	Specific gravity	pH	Titrable acidity, c.c N/10 alkali per 100 c.c.	Crude protein, per cent	Protein nitrogen per cent	Non-protein nitrogen per cent	Ether extractives per cent	Mineral matter, per cent	Carbohydrates, per cent	Calcium (Ca) per cent	Phosphorus (P) per cent	Iron (Fe) Mg. per cent	Calorific value per 100 g.
Milk (Dairy), with inoculum.	89·1	10·9	1·017	5·2	15·3	2·7	0·103	0·022	1·5	0·7	3·0	0·12	0·08	0·19	63
'Buttermilk' (after 18 hrs. fermentation) no dilution	92·1	7·9	1·042	4·5	91·0	2·5	0·398	0·037	2·1	0·7	2·6	0·12	0·09	0·19	39
'Buttermilk' (18 hrs. fermentation and diluted) . 2:1	94·8	5·2	1·020	4·5	68·5	1·9	0·281	0·029	1·5	0·5	1·3	0·08	0·06	0·13	26
'Buttermilk' (18 hrs. fermentation and diluted) . 1:1	96·2	3·8	1·010	4·4	49·0	1·4	0·202	0·023	0·8	0·4	1·2	0·06	0·04	0·10	18
'Buttermilk' (18 hrs. fermentation and diluted) . 1:2	97·6	2·4	1·004	4·2	36·0	0·9	0·135	0·015	0·6	0·2	0·7	0·04	0·03	0·06	12
'Buttermilk' (18 hrs. fermentation and diluted) 2:5	97·8	2·2	1·003	3·8	30·0	0·9	0·113	0·013	0·5	0·2	0·6	0·03	0·03	0·05	11
'Buttermilk' (18 hrs. fermentation and diluted) 1:3	98·2	1·8	1·003	3·8	25·[illegible]	0·7	0·097	0·010	0·5	0·2	0·4	0·03	0·02	0·05	9
'Buttermilk' (18 hrs. fermentation and diluted) . 2:7	98·4	1·6	1·002	3·8	23·0	0·6	0·091	0·010	0·5	0·2	0·3	0·03	0·02	0·01	8
'Buttermilk' (18 hrs. fermentation and diluted). . 1:4	98·6	1·4	1·001	3·8	19·[illegible]	0·[illegible]	0·080	0·007	0·4	0·1	0·3	0·03	0·02	0·04	7
'Buttermilk' (18 hrs. fermentation and diluted) . 1:5	98·8	1·2	1·000	3·8	17·0	0·5	0·065	0·006	0·3	0·1	0·3	0·02	0·01	0·03	6
'Buttermilk' from cream during manufacture of butter—Sample 1.	97·9	2·1	1·003	4·0	21·5	0·6	0·085	0·014	0·5	0·1	0·9	0·03	0·02	0·57	11
'Buttermilk' from cream during manufacture of butter—Sample 2.	97·9	2·1	1·002	4·4	14·0	0·4	0·063	0·009	0·9	0·1	0·7	0·02	0·01	0·17	13

TABLE II

The chemical composition of " buttermilk ", obtained with pure and with mixed culture of B. acidophilus

	Duration of fermentation	Moisture per cent	Total solids per cent	Specific gravity	pH	Titrable acidity, c.c N/10 alkali per 100 c. c.	Crude protein per cent	Protein nitrogen per cent	Non-protein nitrogen per cent	Ether extractives per cent	Mineral matter per cent	Carbohydrates, per cent	Calorific value per 100 g.
Milk (Dairy) with inoculum	hrs 0	89·1	10·9	1·017	5·2	15·3	2·7	0·403	0·022	4·5	0·7	3·0	63
'Buttermilk', made with mixed culture of *B. acidophilus*	18	92·1	7·9	1·042	4·5	94·0	2·5	0·398	0·037	2·1	0·7	2·6	39
'Buttermilk', made with mixed culture of *B. acidophilus*	24	93·0	7·0	1·040	4·5	100·0	2·6	0·389	0·035	2·5	0·7	1·2	38
'Buttermilk', made with pure culture of *B. acidophilus*	18	91·8	8·2	1·023	5·0	31·0	2·5	0·371	0·041	1·4	0·7	3·6	37
'Buttermilk', made with pure culture of *B. acidophilus*	24	91·4	8·6	1·025	5·0	40·0	2·5	0·366	0·041	1·6	0·7	3·8	40
'Buttermilk', made with pure culture of *B. acidophilus*	42	92·3	7·7	1·026	4·5	62·0	2·6	0·357	0·044	1·5	0·7	2·9	36

It is to be seen from the above tables that a little nitrogen is lost on prolonged fermentation, how this loss occurs is obscure. During the process of souring milk the non-protein nitrogen increases, which is presumably due to the splitting up of the complex protein molecule into simpler amino-acids. It is thus possible that the nitrogen of soured milk has a higher biological value than that of sweet milk. The increase in non-protein nitrogen is not proportional to the duration of fermentation. Titrable acidity, as is to be expected, increases with fermentation.

As the dilution increases the amount of fat that separates and can be removed, becomes greater. The composition of the 'buttermilk' at various dilutions as regards elements other than fat is therefore not exactly proportional to the degree of dilution.

The composition of the 'buttermilk' prepared with a pure culture of *B. acidophilus* is not very different from that of 'buttermilk' prepared with impure cultures of this organism, except as regards specific gravity. The former kind of 'buttermilk' is consistently lighter (Table II), which probably is due to a difference in texture of the 'curds' in the two samples.

The chemical composition of a sample of 'buttermilk' of type 1 can be roughly deduced from its content of total solids. In practical nutrition work, determination of total solids, or of specific gravity by an ordinary lactometer may be of service. In diet surveys an attempt should be made to record intake of 'buttermilk' in terms of the original whole milk from which it is derived.

'Buttermilk' obtained from cream during churning (type 3) is of low nutritive value, since most of the nitrogen, fat and ino ganic elements are removed when the original separation of the cream from milk takes place.

NOMENCLATURE

In India the term 'buttermilk' usually means soured milk, with the fat partially removed, and diluted to varying degrees (type 1). Strictly speaking, the term should be applied only to the liquid obtained during the manufacture of butter from cream (type 3). Considerable confusion has been caused by the use of the word to describe products of quite different nutritive value. Vernacular terms may be equally misleading, as is indicated by the following extract from a letter from Colonel Sir Arthur Olver, Animal Husbandry Expert to the Government of India, to the Director of Nutrition Research, Coonoor.

"In the Punjab the word *lassi* is used for three products.

(1) The fluid which remains when butter is made from soured whole milk by churning. Some water is usually added.

(2) The curd prepared from soured whole milk. This contains the whole of the butterfat in the original milk but is diluted with water and thoroughly stirred before taking. This is known as '*adh rirka*' or '*lassi*'.

(3) Ordinary sweet milk diluted with water before drinking is known as '*kachi lassi*'.

These are the names in common use in the Punjab, and presumably the words *chach*' and '*chhas*', used in other parts of India, may have a similar wide meaning. I find that 'buttermilk' is defined in the dictionary as "the liquid remaining when butter has been churned from cream". Whether that cream has been obtained by mechanical separation or by steaming the milk over a water bath does not much matter. This fluid contains only a fraction of the protein and salts in the original milk and that is the meaning which I have always attached to the term 'buttermilk'. Thus to me this term does not at all indicate the product with which you are mainly concerned and which is of such great dietary importance, *viz.*, the fluid which remains after the butterfat has been removed from milk for the production of cream, ghee or butter. That residue contains practically the whole of the protein and salts of the full milk and would, I think, be best indicated in India by using the rather cumbersome caption; 'skimmed or separated milk (*lassi*, *chach*, *or chhas*)'.

The term 'buttermilk' is definitely misleading and I suggest that the above is the only way of indicating the product in which as nutritionists we are mainly interested."

In educational work it is difficult to avoid employing the term 'buttermilk' to indicate soured skimmed milk, diluted or otherwise, since the use of the term is popular and widespread. At present the only way out of the difficulty is to add a description of the method of preparation when dealing with the various milk products consumed in India.

Summary

1. The chemical composition of various types of 'buttermilk' has been investigated.

2. A slight loss of nitrogen was found to occur when fermentation was prolonged. Non-protein nitrogen increased with souring.

3. In practice the composition of a sample of 'buttermilk' can be roughly estimated from its content of total solids or specific gravity by an ordinary lactometer.

4. Confusion is caused by the use of the term 'buttermilk' to denote various preparations. Strictly speaking, 'buttermilk' means the liquid remaining when butter has been churned from cream. The use of the term to describe other milk preparations can be justified only by widespread popular usage. To avoid confusion, the method of preparation should be described when the term 'buttermilk' is employed.

Acknowledgment

This work was carried out under the Indian Research Fund Association.

NOTES

COTTON CULTIVATION IN IRAN

[From an article " Die Landwirtschaftliche Produktion Irans " by Bruno Laupert, in " Der Tropenpflanzer ", Volume 41, No. 2, February 1938 (page 60), (translated by Dr. W. Burns, Agricultural Expert, Imperial Council of Agricultural Research).].

PRODUCTION statistics prepared by the Agricultural Department for the Iranian years 1310 to 1313 are available. The occurrence of errors in the first year of such statistics both in yields and in areas is understandable. The hectare is not yet standardised in all parts of the country. The old unit of surface measurement was the kharwar, but the kharwar was and is a measure of weight also. As a measure of surface it denotes the area on which a kharwar of wheat or barley is used for sowing. 1 kharwar = 100 batman, 1 batman = about 3 kg. (exactly 2970 grms.). Therefore a kharwar is about 300 kg. (exactly 297 kg.). Since 1934 the metric system has been generally introduced into Iran ; also the weights gramme, kilogramme, tonne (metric ton)—thousand kilogrammes. Recent statistics from the Iranian year 1313 (*i.e.*, A. D. 1934) are recorded in the new metric system, *i.e.*, in metric tons, kilogrammes and hectares. These last figures of the year 1313 can therefore be taken as fairly reliable. The production of the most important products was as follows :—

Tons (Metric)

	1310 (1931)	1311 (1932)	1312 (1933)	1313 (1934)
Cotton	25,916	53,257	52,884	92,588

A comparison of the present production figures with those of export in the same years show the following :—

	1310-11 (1931-32)	1311-12 (1932-33)	1312-13 (1933-34)	1313-14 (1934-35)	1314-15 (1935-36)
Cotton	29,600	14,300	26,360	27,823	16,745

Cotton production figures give the seed cotton, export figures only the lint : the relationship of lint to seed cotton weight is about 1 : 2. There seem to be several errors in these statistics.

Cotton.—The area cultivated has increased markedly from 53,000 hectare in 1932 up to nearly 100,000 hectares in 1934, and in 1937 reached 200,000 hectares. The old main centres of production, *viz.*, the centre, the north and the east, have very considerably increased their areas and cotton cultivation has also spread into other parts of Iran. In 1934 the production statistics give for the first time separate figures for American and Iranian cottons, *viz.*,

American—63,269 hectares producing 57,940 tons of seed cotton.

Iranian—33,068 hectares producing 34,648 tons of seed cotton.

The export figures for 1934-35 were :—

4,000 tons Filestani priced at 4·98 Rial* per kilogramme.

11,600 tons American priced at 3·90 Rial per kilogramme.

11,000 tons Iranian priced at 2·75 Rial per kilogramme.

In the year 1935-36 exports were :—

5,000 tons Filestani priced at 4·3 Rial per kilogramme.

6,400 tons American priced at 4·0 Rial per kilogramme.

5,300 tons Iranian priced at 3·6 Rial per kilogramme.

Filestani can be classed among the American sorts (long-staple). It is derived from a cross between Egyptian and American cottons made by the owner Hakimy on the Filestani estate and is about 12 years old. Every year it covers an increased area.

Under the head Iranian is to be understood a form of *G. herbaceum*, which has been in the country for many years and whose capsule does not open at the time of ripening and therefore requires only to be pulled off. At the same time the fibres are shorter and the price therefore smaller. A comparison of the figures of the two areas for 1934 would seem to show that the Iranian variety gives repeatedly better comparison, however, we should consider the areas where at least a thousand hectares of the one or the other sort is cultivated. The following are the figures for the three main such areas :—

Centre					
American . .	13,880 hectares	=	14,771 tons	= 1065 kg.	per hectare.
Iranian . .	1,400 ,,	=	1,505 ,,	= 1075	Do.
North					
American . .	27,700 ,,	=	22,370 ,,	= 807	Do.
Iranian . .	6,000 ,,	=	4,050 ,,	= 675	Do.
East					
American . .	10,204 ,,	=	11,654 ,,	= 1142	Do.
Iranian . .	10,483 ,,	=	10,956 ,,	= 1045	Do.
Total average of the three areas					
American . .	51,784 ,,	=	48,795 ,,	= 942	Do.
Iranian . .	17,883 ,,	=	16,511 ,,	= 923	Do.

*Rial = roughly two annas.

The American kinds show a somewhat better yield per hectare. We can roughly take an average of a thousand kg. per hectare as the yield of either about 300 kg. being lint and 700 kg. seed. However, different prices are paid for the three kinds, both for export and in the inland market. We shall not take the very widely varying prices paid for export in 1934-35 but content ourselves with the figures paid in 1935-36. These were Iranian 3·60 Rial for kg. lint and American 4·15 Rial.

The money value of the cotton produced per acre is as follows :—

Iranian . . 300 kg. at 3·60 Rial per kg. = 1080 Rial per hectare

American 300 kg. at 4·15 = 1245 Rial per hectare

Similar differences appear if one compares the market prices at Teheran for seed cotton. In spring of 1937 these were as follows :—

Filestani . . 1·17 Rial per kg. = 1170 Rial per hectare.

American . . 0·97 Rial per kg. = 970 Do.

Iranian . . 0·70 Rial per kg. = 700 Do.

The management of cotton production including cultivation, working up of the harvested material, distribution and export lies in the hands of monopolistic company formed in August 1935. Cotton production in Iran has greatly increased due to the activities of this company. In the year 1937, it was expected that an area of 200,000 hectares would be cultivated.

Home (Iranian) requirements in the year 1312 were about 8,000 tons and have slowly risen. They were estimated at 12,000 tons in the year 1315 and about 14,000 tons for the year 1316 (1937). The home requirements ought to further increase when the spinning mills now in course of execution, start work. The following table shows the main customers for Iranian cotton in the last five years :—

	1310-11 (1931-32)	1311-12 (1932-33)	1312-13 (1933-34)	1313-14 (1934-35)	1314-15 (1935-36)
	Tons	Tons	Tons	Tons	Tons
Russia . .	28,160	9,490	9,840	19,820	13,990
Germany .	..	2,230	10,330	3,650	2,040
Japan . .	..	34	3,870	1,220	19
British India .	1,450	2,510	1,810	1,230	630

The total export for the last five years is 109,000 tons made up as follows :—

	Tons
Russia	81,300
Germany	18,250
Japan	5,143
British India	7,630

Of the 8,600 tons of cotton sent for export in the year ending 21st February 1937, over 90 per cent has gone to Russia. According to the Customs report the prices move between 4·25 Rial to 5·30 Rial per kg. The monthly Customs bulletin does not however show the kinds of cotton (this is only done at the end of the year) so that the differences in price are understandable. On the other hand, for July-August, 1936, the following prices were noted for lint of the following qualities in the market of Teheran :—

Filestani	5·50	Rial per kg.
American	4·67	Do.
Iranian	5·67	Do.

Cotton prices in the interior market are higher than the world prices obtained for export cotton.

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THE FAR EASTERN ASSOCIATION OF TROPICAL MEDICINE

10th Congress

The 10th Congress of the Far Eastern Association of Tropical Medicine will be held at Hanoi (Address "Igesante", Hanoi, Indochine) from the 24th to 30th November, 1938.

All licensed Medical, Dental and Veterinary practitioners are eligible for membership. The membership fee for the period 1934-38 is £3 (or Rs. 40-2) and should be paid to the Local Provincial Secretaries of the Far Eastern Association of Tropical Medicine, to whom the names of members in their areas should be submitted. The members are also requested to inform the Local Secretaries whether they propose attending the Congress. The titles of any papers which it is proposed to place before the Congress should be submitted to the Local Secretaries at an early date. Arrangements will be made for the reading at the Congress of any paper submitted by a member who is unable to attend.

The Ninth Congress held at Nanking in 1934 decided that sections on Food Problems and Sanitary Measures with reference to Sewage and Garbage Disposal should also be added to the programme of the 10th Congress.

Further information may be obtained from the Local Provincial Secretaries or from Lt.-Col. G. Covell, M.D., D.P.H., D.T.M. & H., F.R.E.S., I.M.S., Director,

Malaria Institute of India, and local Secretary of the Far Eastern Association of Tropical Medicine for Government of India, Kasauli, Punjab, or the Honorary General Secretary, Far Eastern Association of Tropical Medicine, Parapattan 10, Batavia (Centrum) Java.

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THE EMPIRE JOURNAL OF EXPERIMENTAL AGRICULTURE

THE January 1938 Number of the Empire Journal of Experimental Agriculture again contains several articles of Indian interest, as will be seen from the list of contents reproduced below :—

The Application of Science to Modern Tea Culture, by P. H. Carpenter.

Manuring *Hevea*, II. Revision of Experimental Results by means of a Sampling Method for Yield, by W. B. Haines.

Cereal Grains as a Source of Nutritionally Useful Phosphorus, by L. C. Snook.

The Relation between Body-conformation and Productivity in the Cyprus Fat-tailed Sheep, by M. Finci.

The Relative Values of Organic and Inorganic Nitrogen Fertilizers, by A. H. Lewis.

Experimental and Statistical Technique of Some Complex Cotton Experiments in Egypt, by F. Crowther and M. S. Bartlect.

The Chemical Composition of the Grain and Straw of Varieties of Oats bred at the Welsh Plant Breeding Station, by W. M. Ashton.

Dicalcium Phosphate and Steamed Bone-flour as Supplements for a Phosphorus-deficient Ration, by W. Godden and S. C. Rây.

The Cattle of the Gold Coast, by J. L. Stewart.

The Potato Industry in Jersey, by D. Simpson and T. Small.

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RESEARCHES IN CHEMOTHERAPY

(Reprinted from *Nature*, September 4, 1937, with kind permission of the author, Dr. F. L. Pyman and the Editor, *Nature*).

CHEMOTHERAPY, which forms the subject of Dr. F. L. Pyman's presidential address before Section B (Chemistry), may be regarded as the treatment of disease by chemical substances, which have been shown by biological methods to be relatively much more toxic to pathogenic organisms than to human or other animal hosts.

Chemotherapy was developed by Paul Ehrlich, and its most outstanding achievement has been the introduction of the arsenic group of spirochaeticides.

In the field of bactericides, the introduction of phenol as an antiseptic by Lister in 1867 has led to the study of many derivatives of phenol. Recently systematic studies of various homologous series of phenols have resulted in the introduction into medicine of hexyl-resorcinol and amyl-*m*-cresol, the latter having a Rideal-Walker coefficient of 280.

The chemotherapeutic investigation of amoebicides was greatly facilitated by the *in vitro* test for amoebicidal efficiency developed by Dobell and Laidlaw. Using this test, Coulthard studied a series of alkyl derivatives of harmol prepared in Messrs. Boots' Laboratories and showed that peaks of bactericidal efficiency were reached at butylharmol for *B. typhosus* and at amylharmol for *S. aureus*, whilst peak amoebicidal activity was found in O-*n*-nonylharmol. Salts of members of this series were, however, very sparingly soluble in water, and in order to obtain more soluble compounds the corresponding dialkylamino derivatives were prepared and their amoebicidal activities compared with that of emetine. Although the most active member was not as active as emetine, it had several times the activity of O-*n*-nonylharmol and it was suspected that the harmol residue might not be the important contributor to the amoebicidal properties of the molecule and that the dialkyl-aminoalkyl group might play an important part. This led through various intermediate stages to the preparation and study of a series of tetra-alkyldiamino paraffins and of these *αx*-tetra-*n*-amyldiaminodecane was found to be the most efficient. For brevity, the compound is referred to as T.A.D.D.

The preceding results had shown that, when tested by the Dobell and Laidlaw technique, T.A.D.D. was the most active amoebicide so far prepared. It now became necessary to compare the efficiency of this compound with that of emetine under conditions as similar as possible to those found in the intestine of a dysenteric patient. When tests were carried out under these conditions T.A.D.D. was found to be more active than emetine. As originally pointed out by Ehrlich, the therapeutic value of a substance is a function of its toxicity to both parasite and human host. It became necessary, therefore, to determine the relative toxicities of T.A.D.D. and emetine to mice. The results of such a test showed T.A.D.D. to be from one-third to one-eleventh as toxic as emetine, depending on the method of administration.

T.A.D.D. had thus a greater *in vitro* amoebicidal activity and was less toxic to mice than emetine. These results appeared to justify the clinical trial of the compound in the treatment of amoebic dysentery.

Such a trial was carried out by Prof. Warrington Yorke, at the request of the Therapeutic Trials Committee of the Medical Research Council. Unfortunately, T.A.D.D. proved to be too irritant for parenteral administration and it was not sufficiently active to be of any real value when given orally.

Whilst this investigation has not yielded a compound of clinical value, it has resulted in the accumulation of valuable data which will be of value in further work on this subject.

The account of such an investigation indicates the enormous amount of chemical and biological team work involved in attempts to evolve new drugs for the treatment of disease.

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THE MAYNARD-GANGA RAM PRIZE

APPLICATIONS are invited for the "Maynard-Ganga Ram Prize" of the value of Rs. 3,000 which will be awarded for a discovery, or an invention, or a new practical method tending to increase agricultural production in the Punjab on a paying basis. The prize is open to all, irrespective of caste, creed or nationality and Government servants are also eligible for it. Essays and thesis are not eligible for competition and applicants should prove that some part of their discovery, invention, etc., is the result of work done after the prize was founded in 1925. The Managing Committee reserves to itself the right of withholding or postponing the prize, if no satisfactory achievement is reported to it. All entries in competition for the next award should reach the Director of Agriculture, Punjab, on or before the 31st December, 1938.

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THE following communications have been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

WHEAT SOWINGS AND THE WORLD WHEAT OUTLOOK

THE International Institute of Agriculture considers, on the basis of the information received up to mid-February, that the area sown to winters wheat in the northern hemisphere is almost as large as that sown last year which was the largest recorded. The Institute also reports that the sown area is particularly extensive, with few exceptions in the surplus producing countries, including, in particular, the United States, the U. S. S. R. and the Danube countries. The area of winter sowings in this group of countries is apparently at least as large as the second area of last year and much above the average of the years 1932 to 1936.

Reviewing the position of sowings and the present market situation, the International Institute of Agriculture considers that if the spring area in North America and the U. S. S. R. and the sowings in the southern hemisphere are not

considerably smaller, a very unlikely result, and if the average yield is not substantially below normal, the coming commercial year will be marked by rather considerable over production and an unstable position on the world wheat market.

At present all that can be said on the outlook is that the condition of the winter crops is rather uneven in the United States, but generally satisfactory in Europe, the U. S. S. R., India and North Africa.

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WORLD SUGAR PRODUCTION AND MARKETS

THE International Institute of Agriculture gives the following information on world sugar production and markets.

The production of beet-sugar, which is centred almost entirely in Europe, the Soviet Union and North America, appeared larger and larger as the manufacturing season advanced. The season is now almost finished and it may be stated that the production of beet-sugar in 1937-38 is the largest since the War, with the exception of 1930-31.

The Soviet Union has a record production of about 2·5 millions metric tons of raw sugar, or 85 per cent larger than the average of the five years 1931 to 1935. The other European countries have for the most part shown increases ranging up to 50 or even 100 per cent above the average. In spite of the rather unsatisfactory results in certain countries, the most important of which are France and Great Britain, the total European production of raw sugar is a million metric tons or 16 per cent higher than the average of 1931 to 1935.

This result is due essentially to a heavy increase in beet production in the largest producing countries except France, namely in Germany, Czechoslovakia, Poland, and also to some extent to increases in certain minor European producers.

The production of the two North American producing countries, United States and Canada, is very slightly below the average.

The total world production of beet-sugar including the Soviet Union, this year should exceed 11 million metric tons. This figure is 0·9 million or 9 per cent larger than last year, and 25 per cent above the average of 1931-35, and is within 0·4 million of the record of 1930.

In addition to this very large production of beet-sugar, it seems certain that there will also be an abundant production of cane-sugar. This year's production should be almost equal to last year's and exceed that of all earlier years.

In short, the total production of beet and cane-sugar in the 1937-38 season seems to be equal to or higher than the maximum reached in 1930-31.

This production may well disturb the world sugar market. Already a decline in sugar prices is reported, which is especially serious on the New York market, but was also appreciable in London and Prague at the end of 1937. Quotations of Cuban sugar on the New York Exchange fell in December 1937 to the average level of 1935 ; though prices were better maintained on other markets and were even at times high, the drop of American prices represents a serious symptom which might reasonably cause fears of another crisis on the world sugar market.

Since May 1937, however, there has existed an agreement concluded at London between the great majority of producing countries, which aims at fixing the export quotas of producing countries for a period of five years ; it also covers the regulation of the free market between certain importing countries and their colonies or dependencies. It is designed in principle to maintain the equilibrium between the world supply and demand of sugar.

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THE PREPARATION OF THE SECOND WORLD AGRICULTURAL CENSUS

THE International Institute of Agriculture, which in 1930 organized the First World Agricultural Census, is now completing its programme for the Second Census to be taken in 1940.

For this purpose, in December last it assembled a conference of agricultural statisticians at which were represented the majority of the European countries and their colonies and several countries of other continents, together with the Secretariat of the League of Nations and the International Labour Office. The programme compiled from the suggestions of this Conference will be addressed to the Governments of all countries in the world to be put into practice, according to their particular conditions, in 1940.

The aim of the census is to ascertain agricultural production as accurately as possible, and, in general, to secure exact information on the agricultural and rural economy of the various countries of the world.

It is also of importance that each State should know the conditions of agriculture in the neighbouring countries and in the countries with which it has economic or commercial relations. It requires such knowledge in order to direct its foreign trade and to compare its own position with that of other countries.

To secure such knowledge, countries require a good periodical documentation on the agricultural utilization of land and on the characteristics of its exploitation and vegetable and animal production.

These considerations have already led a number of countries to undertake agricultural enquiries, more or less regularly, but these enquiries were conducted

at different times and with a great diversity of method. The International Institute of Agriculture considered that it was of the highest interest to co-ordinate these efforts and the programme it has drawn up is designed to secure this co-ordination, which, from the international point of view is indispensable.

It believes, however, that the success of this second census depends on the co-operation of Governments and also on the collaboration of agronomists, technicians and farmers of all countries.

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SUPPLIES AND WORLD WHEAT REQUIREMENTS

THE International Institute of Agriculture having revised, from the data and reports received since October, the statistical position of the present wheat season, publishes the following conclusions on supplies and world wheat requirements.

World exportable supplies are estimated at 736 million bushels, or 34 million less than the forecast made in October. They are very little larger than those of the last two seasons, which were among the lowest recorded for a long series of years. Their smallness is due partly to the bad crops of Canada and Argentina and partly to the minimum exportable stocks with which the season began. only about an eighth of the total surplus, or 88 million bushels, consists of stocks carried over from previous seasons, the remainder, supplied by the 1937 crop, being 648 millions.

The probable requirements of importing countries stand, after revision at 520 million bushels, or 15 millions less than the October forecast, due to a decrease in the probable demand of Europe, which is reduced from 420 million bushels to 405 millions, while the probable demand of extra European countries is maintained at 115 million bushels. At this level, world import requirements are, with those of 1935-36, the smallest since the Great War. Against last year they show a decrease of 82 million bushels or 14 per cent.

The figures of the wheat trade in the first six months of the present season, August 1937 to January 1938, show that net wheat exports from all the exporting countries were 266 million bushels, whereas the corresponding figure for the last season was 323 millions. Imports of European countries in the same period were 192 millions against 180 last year, but they are forecasted for the second half season at 213 millions, compared with 258 millions in February—July 1937. On 1st February quantities afloat for Europe were larger than those at the beginning of the season (37 against 26 million bushels), but much lower than on 1st February 1937 (54 millions).

The predicted decline in international wheat requirements, which is confirmed by the trade movements of the first half of the season, is to be attributed in the

case of European importing countries to the large resources at their disposal, which reinforce their general policy of import restriction, and in the case of extra-European countries to the discontinuance of imports into the United States, Morocco and Tunisia following the good crops of 1937, in addition to smaller purchases by other large consuming countries (Brazil, China, Japan, etc.).

From a comparison of total import requirements of countries with a net import and the exportable supplies of those with a net export, it is apparent that the exportable surplus from the 1937 crop (648 million bushels) is amply sufficient, in spite of the failure of the Canadian and Argentine crops, to cover the forecast world demand (520 million bushels), so that, for the first time since 1930, a part of the exportable surplus (128 millions) will be held in reserve and carried over to next season. Accordingly exportable stocks, which after several years of steady decline were reduced on 1st August 1937 to a minimum level (88 million bushels), should on 1st August 1938 be about 216 million bushels, a slightly lower figure than was forecast for last October (235 millions) but still approximately equal to what was regarded as normal before the great wheat crisis.

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HANDBOOK OF COEFFICIENTS AND EQUIVALENTS : A STATISTICAL PUBLICATION OF THE INTERNATIONAL INSTITUTE OF AGRICULTURE

THE International Institute of Agriculture has just published a completely reset edition of its Handbook of Coefficients and Equivalents. (*Recueil de coefficients et d'équivalences*).

This small volume was originally produced for the use of the Statistical Bureau of the Institute in the conversion into metric units and *vice versa* of the data expressed in other measures, for the calculation of gold prices and similar purposes. Its usefulness proved much more general and it met with a cordial reception from statisticians and economists throughout the world, with the result that three subsequent editions, the last dating from 1922, were called for. The numerous changes in measures and monetary units, due not least to the unstable conditions in this field in the last decade, since then have made it necessary once again to bring the volume up-to-date. The opportunity has been taken not only to carry out a revision but to make a number of additions, both in the general information published and in the conversion tables.

The new edition, which has been completely reset and considerably enlarged, comprises 295 pages (*Recueil de coefficients et d'équivalences*, 295 pp., Rome, International Institute of Agriculture, 1937. Small 8°).

The first part gives the units of measure and their metric equivalents, monetary units, parities and approximate indication of actual exchanges for 116

countries. The second part comprises 96 tables of equivalents for metric measures in British and American units and auxiliary tables for the conversion of sterling and rupee prices.

The material is preceded by an introduction indicating the rules to be followed in making reductions, calculating percentages, indices, etc., and is followed by an analytical table and alphabetical index.

In this new form the *Recueil de coefficients et d'équivalences* published by the International Institute of Agriculture is a very valuable tool for statisticians and economists throughout the world.

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BULLETIN OF THE UNITED PROVINCES FRUIT DEVELOPMENT BOARD

Marketing Series

THIS bulletin is issued fortnightly by the Provincial Marketing Officer, United Provinces, Lucknow, for the United Provinces Fruit Development Board. Single copy As. 2, annual subscription Rs. 2-8. It is distributed free to the members : the annual subscription for membership of the Fruit Development Board is Rs. 10. The publication of this bulletin is part of the scheme prepared on behalf of the United Provinces Fruit Development Board. The scheme consists of the appointment of subsidized commission agents in the important markets of the United Provinces on specified terms for the disposal of the fruits of the members of the Board. The commission agents are required to deposit security to the Board as a guarantee of good faith and their work is supervised by three Marketing Supervisors and a Marketing Inspector under the control and general supervision of the Provincial Marketing Officer. Orchardists will do well in joining the Fruit Development Board and making use of the facilities provided by it for marketing their produce.

The bulletin gives wholesale and retail prices of fruits in some of the important markets of the United Provinces and other useful information, such as, trend of prices, demand, forecasts of crops, list of commission agents, weight of fruit packages, number of fruits in a container and the number of packages and quantity of fruit in a wagon load. The bulletin serves as a good medium for advertising fruits and fruit plants.

It is hoped that the example set by the United Provinces Fruit Development Board will be emulated in other provinces and states in India.

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THE PUNJAB PROVINCIAL CO-OPERATIVE FRUIT DEVELOPMENT BOARD

The Co-operative Fruit Development Board, Punjab, has issued a new series of bulletins dealing with fruit industry in foreign countries, namely, Egypt, Palestine, Italy, France and Switzerland. These bulletins are based on the notes taken by the author (S. Lal Singh, Fruit Specialist) during his tour in these countries from April to October 1934. The information contained will be found interesting by all lovers of fruit industry as different aspects of fruit culture of western countries are dealt with in a clear manner. The first few pages in each of these bulletins are devoted to the general information in regard to the area, population, status of fruit industry and various legislations passed to promote the general activities of the horticultural departments. This is followed by brief notes on the varieties of fruits grown in various localities, horticultural practices followed and hints on the cultivation of fruits as practised there. Nurserymen and horticultural departments desirous of introducing new varieties for trials would find in these bulletins sufficient information regarding varieties of fruits found successful as well as the characteristics of the same. The amount of money and labour spent on fruit industry in these countries is also given. This shows how much India is backward in this respect and how much more is needed to come to the level of development of these countries. The bulletins are well illustrated which makes them still more interesting. [R. L. S.]

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STATISTICS OF THE PRODUCTION OF CERTAIN SELECTED INDUSTRIES IN INDIA

THE following statistics are reproduced from the "Monthly Statistics of the Production of Certain Selected Industries of India for September, October, November and December, 1937".

Detailed statement of the quantity and description of jute manufactures produced in India

Description		Month of September 1936	Month of September 1937	Month of October 1936	Month of October 1937	Mohth of November 1936	Mohth of November 1937	Month of December 1936	Month of December 1937
I.—Twist and Yarn	tons	4,412	4,725	4,397	4,311	4,379	4,709	4,816	5,095
II.—Manufactures—									
Canvas	tons	106	250	60	213	94	216	165	201
	yds.	214,117	564,857	118,743	484,411	183,641	458,518	342,334	407,708
Gunny Bags—									
(a) Hessian	tons	5,095	4,318	4,673	3,792	4,832	4,975	5,130	4,582
	No.	10,442,171	8,582,215	10,396,451	8,922,394	11,239,065	16,723,982	12,015,796	11,227,845
(b) Sacking	tons	56,322	59,541	54,032	50,104	53,590	58,122	57,357	60 381
	No.	54,901,034	58,964,292	52,942,726	49,908,203	50,674,282	56,909,704	55,653,027	58,490,675
Gunney Cloth—									
(a) Hessian	tons	42,804	44,638	42,005	38,326	40,601	43,442	42,909	44,664
	Yds.	164,602,649	171,878,889	160,549,064	143,808,605	154,336,022	167,240,839	165,076,325	171,053,179
(b) Sacking	tons	2,285	2,731	2,933	2,017	2,425	2,600	2,930	2,202
	yds.	5,356,957	6,244,497	6,160,391	4,884,479	5,463,935	6,630,969	6,665,667	5,361,817
Other Manufactures including Rope and Twine tons.		508	384	525	348	842	484	488	476
Total	tons	111,532*	116,587	108,625*	99,111	106,763*	114,548	113,795	117,601
	yds.	170,173,723*	178,688,243	166,837,198*	149,177,495	159,983,598*	174,330,326	172,084,326	176,822,704
	No.	65,343,205*	67,546,507	63,339,177*	58,830,597	61,913,347*	73,633,686	67,668,823	69,718,520

*Revised.

Detailed statement of the quantity and description of sulphuric acid produced in India

Description	Month of September		Month of October		Month of November		Month of December	
	1936	1937	1936	1937	1936	1937	1936	1937
	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.	Cwts.
Sulphuric Acid—								
(i) Ordinary or non-fuming	45,149*	46,458	54,762*	56,896	50,673*	52,488	43,223	52,034
(ii) Fuming . . .	...	...	...	10	12	...	...	...

*Revised.

Detailed statement of the quantity and description of sulphate of ammonia produced in India

Description	Month of September		Month of October		Month of November		Month of December	
	1936	1937	1936	1937	1936	1937	1936	1937
	Tons	Tons	Tons	Tons	Tons	Tons	Tons	Tons
Ammonium Sulphate—								
Neutral	1,435	1,731	1,544	1,619	1,387	1,468	1,467	1,622
Acid	29	45	41	46	38	43	48	35

Detailed statement of the quantity and description of sugar produced in India

Description	Month of September		Month of October		Month of November		Month of December	
	1936	1937	1936	1937	1936	1937	1936	1937
	Cwts.	Cwts.	Cwts.	Cwts	Cwts.	Cwts.	Cwts.	Cwts.
(i) *Khandsari* Sugar* .	588	937	1,587	168	1,060	1,674	3,798	3,410
(ii) All other Sugar except Palmyra Sugar . .	135,361	100,479	149,231	120,149	581,907	311,740	3,223,242	2,733,758
(iii) Palmyra Sugar . .	33,059	17,314	31,795	6,510	27,096	9,609	22,778	9,244
Total .	169,008	118,730	182,613	126,827	610,063	323,023	3,249,818	2,746,412

* Figures relate to excised issues only.

Detailed statement of the quantity and description of wheat flour milled in India

Description	Month of September		Month of October		Month of November		Month of December	
	1936	1937	1936	1937	1936	1937	1936	1937
	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.	Mds.
Flour	503,150	567,143	538,445	594,688	470,421	569,587	541,899	605,881
Atta . { High grade . .	288,235	324,654	313,977	356,215	274,066	305,038	299,380	310,220
Atta . { Low grade . .	147,254	215,980	176,760	212,670	162,709	238,783	186,690	257,132
Bran	220,234	276,063	243,984	295,259	202,467	279,041	238,767	281,067
Soojee	53,920	88,058	74,744	113,312	59,059	80,047	64,548	70,498
Others	7,495	10,607	16,214	11,348	5,000	13,812	7,176	16,804
Total .	1,220,288*	1,482,505	1,364,124*	1,583,492	1,178,722*	1,486,308	1,338,460	1,541,602

* Revised.

ABSTRACTS

Studies in plant breeding technique, III. Crop analysis and varietal improvement in Malvi *jowar*, J. B. HUTCHINSON, V. G. PANSE, N. S. APTE and B. M. PUGH. (*Ind. J. Agric. Sci*, **8**, *131*).

THE present status of *jowar* in Central India has been surveyed and the possibilities of crop improvement by selection studied.

Snowden's classification is shown to be inadequate to the needs of agricultural botany. The *jowars* of Central India are assigned to one of his main groups (*Sorghum durra* Stapf), and it is shown that the limits of at least three of his species in this group are transgressed in the single, variable, inter-breeding crop population.

Results of a crop analysis carried out in Malwa and Nimar are described and compared with those obtained from a similar study on cotton by Hutchinson and Ghose.

Two years' mass selection had no appreciable effect on the yield of Malvi *jowar*.

Progeny row work was carried out in replicated randomised blocks as described by Hutchinson and Panse. Large and highly significant differences in yield between progenies were demonstrated in each season and three strains, one significantly superior to the local in yield and the other two of considerable promise, were isolated. It is suggested that the plant breeder should endeavour to retain as wide a range of material as possible in " small bulks " trials to improve his chances of discovering some strains superior under all environmental conditions. (*Authors' abstract*)

Micro-climatology of an irrigated cotton field in Sind. B. M. DABRAL and S. S. CHINEY. (*Ind. J. Agric. Sci*, **8**, 161).

TEMPERATURE and relative humidity inside the cotton crop grown under irrigated conditions in Sind were recorded periodically by means of an Assmann's Psychrometer, the results of which are presented and discussed in this paper.

The micro-climate inside the developing crop of cotton, when compared with the ordinary air conditions prevailing outside, differs in many respects. Outside factors exert the basic pull on all situations, but the periodicity of irrigation to the crops acts against this pull and modifies the crop environment considerably. When the crop has attained its maximum size, the crop environment inside, assumes the nature of a perpetual cloudy weather. The temperature and relative humidity inside a crop are farthest away from the normal just after an irrigation. As the soil underneath the crop dries, inside conditions tend to approach those obtaining outside,

till again deflected widely by another irrigation. This super-imposes a periodicity over the normal daily and seasonal trends of climatic variations of a locality.

The growing plant thus experiences a variety of climatic conditions during its life. Apart from the daily weather changes, the frequency and the quantity of irrigation has the most dominating influence on the climate inside and over a crop, specially in an arid tract like Sind. The shade of the crops creates a separate environment for such organs of the plants as lie inside, while their top and sides, which get direct sunshine for varying periods of time during the day, experience altogether a different kind of climatic cond tions. (*Authors' abstract*)

Some leaf diseases of *Hevea brasiliensis* new to India. M. Mitra and P. R. Mehta. (*Ind. J. Agric. Sci.* **8,** 185).

A disease of young leaves of rubber plant (*Hevea brasiliensis*) was reported early in 1936 from a plantation in South Travancore. It was noticed to do a good deal of damage at the time of annual refoliation and was accompanied by abnormal leaf fall. The young leaves were free from spots but badly shrivelled, while the mature leaves were badly spotted. The cause of the disease seems to be *Oidium hevae* Steinman and *Gloeosporium alborubrum* Petch. Another fungus isolated from the diseased leaves was *Colletotrichum ficus* Kds. with its perfect stage *Glomerella cingulata* (Stonem.) S. and V. S. These fungi have not been recorded previously from India on *Hevea brasiliensis*. (*Authors' abstract*)

Some experiments on the carotene content of grasses and concentrates and the feeding of Guinea grass to dairy cows. J. K. Makhijani and B. N. Banerjee (*Ind. J. Vet. Sci. & Anim. Husb.* **8,** 13).

The carotene content (carotinoid pigment after separation of chlorophyll and xanthophyll) of seventy-three samples of grasses, hays, and other fodders, has been determined. In the mature green stage, grasses contain 18 to 56 mg. Silage of Guinea grass contains only 4 mg., while the grass itself contains 50 mg. Maize, *bajri*, and *ragi* at the flowering stage contain 24 to 96 mg. but in the straw or fodder stage, very little. Legumes like *kulthi*, *methi*, soya bean, cowpea, peas, and *karai* contain 98 to 182 mg. Lucerne 164 and Paspalam 260, are very rich sources for carotene. Dry grasses from forest areas and hays and straws are very poor in this respect. Of the fifty-two concentrates examined, most of them contained nothing or at the most traces in a few samples. By increasing the proportion of guinea grass (carotinoid feed) it is possible to increase the carotene content in the blood and milk of cows. The vitamin A content of the butterfat is, however, not materially altered. (*Authors' abstract*)

'Soil conservation districts'. D. S. Myer. (*Agricultural Engineering*, March 1938, Pp. 111 to 113).

(D. S. Myer is the Chief of the Division of Co-operative Relations and Planning Soil Conservation Services, U. S. Department of Agriculture and he presented this paper before the Soil and Water Conservative Division at the meeting of the American Society of Agricultural Engineers at Chicago, December 1, 1937).

Erosion can be controlled effectively only by treating each bit of land according to its own needs and adaptabilities. Steep or highly erodible land should generally be planted to a growth of trees or shrubs ; intermediate areas in permanent pasture ; crop production should be confined to those parts of the farms where erosion can be checked by rotations, engineering devices and proper methods of cultivation. The ideal is a proper combination of agronomic measures, simple engineering structures and approved methods of forestry. Programmes of this general type are being carried out in co-operation with the Soil Conservation Service by more than 50,000 farmers and ranchers. Each of these areas was selected to typify a broad surrounding agricultural region. The demonstration operations are not intended as a complete solution to the erosion problem but merely as guide posts helping to point the way to solution. They cover something less than 3 per cent of the total agricultural area in the U. S. A. Yet it is estimated that 75 per cent of this area is either actually or potentially subject to some form of erosion damage. There is real need of a mechanism whereby erosion control measures which have proved effective can be applied over considerable of our erodible land. In the first half of 1937 the legislatures of twenty-two American States passed enabling laws setting up state soil conservation committees and permitting the formation of local districts for the purpose of controlling erosion. These enactments are of a democratic character. Actual organisation of a district can come only after public hearings have been held and at least a majority of land occupiers, voting in a referendum, have signified their approval. Once created, the district is governed by a board of five supervisors, three of whom are elected by local balloting and two appointed by the state committee. But no important step in procedure can be taken without consulting the will of the majority of land occupiers themselves, and numerous safeguards are provided to protect the individual against any possible injustice. Once organised, the district functions as a Governmental sub-division of the state with all the privileges ordinarily pertaining to such units. The district may conduct erosion control projects. It may enter into contracts with individual farmers and assist them in the formulation of soil conservation programmes and the adoption of erosion control practices. It is almost inevitable that in the near future a large number of districts will turn to the Soil Conservation Service for aid and advice. The experience gained by this Service from operation of the demonstration programme over a four-year period combined with the knowledge obtained by other agencies, has crystallized into a comprehensive fund of practical information on soil and water conservation. The Service will fully co-operate with those districts which approach the problem of erosion control in an effective manner. The precise form of this co-operation cannot be established until an adequate background

of experience has been acquired. The amount of the Service's aid to a particular district will probably be determined to some extent by the programmes and work plans which are adapted. In general, the Service will provide a certain amount of technical assistance. Technicians released from project duty under the Service, will be made available to districts as they are needed. In certain cases monetary grants or other services may be given, *e.g.*, construction supplies or planting stock of new or uncommon varieties of erosion-resistant vegetation. In all cases the total amount of such contributions should be matched by state or district funds made available for erosion control purposes. The policy relating to this type of supplemental service has not been fully worked out. Under the district, the District Supervisors are responsible for the adoption and carrying out of programmes and work plans within the area. Other important pieces of land conservation legislation by the U. S. Federal Government are the following :—

(1) The Flood Control Act of June 1936 which is significant in relating the problem of flood control with that of land use.

(2) The Water Facilities Act passed at the last session of the Congress which links up the problem of land use with that of water conservation. Under it the Department of Agriculture is authorised to develop and carry forward a programme for the conservation and utilisation of water in arid and semi-arid states. It is recognised that the success of all these movements depends very largely on the whole-hearted co-operation of all interested national, state, and local agencies, both governmental and private. (*W. B.*)

A note on a new method of control for insect pests of the cotton plant., T. G. Mason and E. Phillis. (*Emp. Cotton Growing Rev. Vol. XLV, No. 4*).

Following certain observations by Hurd Karrer on the toxicity of selenium and selenium-containing plants to aphids, the authors have tried out the possibility of using selenized cotton plants as a trap for cotton stainers and pink bollworm. Trials with cotton plants grown in sand-cultures, on nutrient solutions containing different concentrations of sodium selenate, showed that growth was strongly depressed when the concentration exceeded 50 p.p.m. During growth it was noticed that the selenized plants were not repellent to the aphids, but that the infestation on such plants was at a much lower level than on the control ones. The feeding of cotton stainers (*Dysdercus Howardi* B) with the green bolls of selenized plants resulted in the death of all the insects in those cases where the selenium concentrations were 10,20 and 50 p.p.m. and 60 per cent of the insects where the selenium concentration was 5 p.p.m. It was, however, found that as development proceeded the stainer became more resistant to selenium poisoning. Similar experiments with pink boll-worm were less conclusive owing to the difficulty of breeding them in captivity but they showed that though the moths were not repelled by the selenized plants, there was considerable mortality in such bolls. (*P. S. S.*)

The application of science to modern tea culture. P. H. CARPENTER, Chief Scientific Officer, Indian Tea Association. (*Emp. J. Expt. Agric. Vol. VI, No. 21*).

THE adoption of scientific methods by tea industry may be said to have begun in the present century. Mann in studying the problems of North-east India quickly realised that one of the main troubles was the loss of soil fertility and the inability of the deteriorated soil to supply the necessary quantity of nitrogen to the bushes. The supposition that the use of artificial nitrogen on tea soils exhausts the soil of organic matter is the reverse of the truth. Results of the experiments conducted at Tocklai made it clear that at any rate for tea culture there might be no fear that the use of an inorganic manure such as sulphate of ammonia would deplete the soil of organic matter so long as the tea prunings are incorporated in the soil. It would also seem that incorporation of this kind of organic matter as prunings into the soil is sufficient for soil requirements and consequently no gain in crop is obtained by the use of bulky organic manures. Experiments have shown that for the same application of nitrogen cattle manure possesses about ½ to ¼ the efficiency of sulphate of ammonia. The tea crop and the quality of the finished tea can be maintained by the use of moderate annual application of nitrogen only which can most efficiently be given in the form of sulphate of ammonia up to a maximum of 300 lbs. per acre. This result has made it to reduce the cost of the manurial programme by about 25 per cent or more—a very valuable saving under conditions that impose strict economy.

The use of phosphatic manure either alone or in conjunction with other manures has so far found to have little effect on the crop. The use of potash as a manure has shown conflicting results. It has improved the quality in Ceylon but has deteriorated it at Tocklai. These apparently contradictory results may be due to the difference in the amount of potash in tea leaves at the two places.

The results of cultivation trials indicate that for tea (a perennial crop) annual soil stirring does not appear to be necessary. Although such a method as hand-weeding and entire suppression of weeds can be practised satisfactorily on flat lands it has been found to result in soil erosion on slopes.

It is in the direction of variety selection and production of uniformity in the progeny of tea seed-gardens that the next big development in tea culture is likely and the importance of research in this direction is now recognised throughout the industry. The progeny of all seed-gardens is much hybridised and it is evident to any casual observer that the plant raised in any one seed-garden gives progenies which differ considerably among themselves in appearance. A very great improvement would result if uniform characteristics could be achieved in the product from any one seed-garden. The work of vegetative reproduction by breeding and selection of bushes for some desirable quality is in progress in Java, Russia, Tocklai and Ceylon.

In pests and diseases the recognition of root disease causing the death of bushes has resulted in the adoption of methods to prevent it from spreading. The study of disease organisms has greatly decreased the casualties. Leaf diseases are controlled by systematic spraying and pruning. The disease that enters through pruning-cuts is still a difficult and as yet an insoluble problem. The problem that is still

serious is how to treat rotting pruning-cuts on old bushes ; so far no satisfactory solution has been found.

On the manufacturing side three theories of tea fermentation, *i.e.*, (1) that it is purely a chemical reaction, (2) that the reaction depends upon the presence of enzymes naturally present in tea leaves and (3) that that enzymes exist in the cells of micro-organisms but not in the cells of tea leaves, have received attention. For a long time it has been evident that none of these theories can satisfactorily explain all the happenings in the factories but it is now appreciated that both the enzymes, *i.e.*, of the tea plants and of the micro-organisms may be active in tea factories. Chemical analysis has revealed the important effect that the constitution of the tannin found in tea differs from that of digallic acid (tannic acid of the British Pharmacopea). This discovery is of much importance for it is no longer permissible to attribute the physiological reaction or digallic acid to the tannin of tea. This has often been done in the past by medical men and has led to much misrepresentation in regard to tea-drinking. (*R. L. S.*)

Manuring *hevea*, II. Revision of experimental results by means of a sampling method for yield. W. B. Haines, Field Research Officer, Dunlop Plantations, Ltd. (*Emp. J. Expt. Agric. Vol. VI, No. 21*).

A new system of recording yield by a sampling method has been introduced in the Dunlop manurial experiments on rubber which has improved the reliability by avoiding certain human sources of error and has increased the detailed information obtained. The older method was designed with the main object of fitting in with ordinary estate routine. Plot sizes were arranged to correspond with tasks and the collection and carrying of latex samples was left to the tappers, who had no appreciation of the experimental requirements. In the new method these weaknesses have been removed. An independent proportional random sample of trees is taken on certain days and the yields are recorded by a special man who does all the work of collecting, coagulating and weighing the latex properly. Blocks of treatments are dealt with in one day, so that day-to-day change (weather) is eliminated with blocks in the analysis. The method by giving individual tree yields is eminently suitable for following through the interesting details of yield-reactions during wintering periods when abnormal yields or rapid changes occur. The data collected well illustrates greatly extended information made available by the new method of recording.

The new results recounted refer to the eleven 25 plot experiments described in the previous paper where the results extended to the end of 1931 the fifth year of action of the manures. The present account covers yield taken between May and October 1937, the seventh year of manuring. The changes shown are therefore a combination of the advance in the field responses and of such corrections as the improved technique of recording has introduced. The data cannot be regarded as definitive but they are of sufficient volume and consistency to establish a new interpretation. The new figures show in every case significant increases due to manuring. The average

effect of the complete inorganic fertiliser is significantly greater than that for any other treatment. The superiority of this over sulphate of ammonia is distinctly established in six cases out of eleven. One must therefore revise the conclusion expressed in the previous paper that complete inorganic fertilizer and sulphate of ammonia were for practical purposes nearly equal. In the past there was a tendency to represent the yields from all manured plots as more uniform than the facts warranted.

In regard to the economics of treatment the average of all the experiments indicates a very wide margin of profit from the treatment with sulphate of ammonia (70 to 80 per cent). The complete inorganic and the NK treatments give a small margin only whilst the organic mixture is too costly for any profit. Nitrogen can be given as the chief requirement with the least risk of extravagance and the best times and amounts of mineral additions leave much room for conjecture though their ultimate value seems clearly established.

Progress has also been made in the interpretation of the effects of the manures on growth. The previous paper suggested a girth increment rate of 0·5 in. per annum as a standard below which need of manuring would be in much evidence. It would now appear that a good response has been shown in experiments where the control has not fallen so low and the suggested standard may be raised to 0·7 in. per annum. A rough rule to be used in conjunction with other field observations is also indicated, *i.e.*, starved conditions may be presumed if the growth rate has fallen much below half the average rate since planting. Measurements of growth and of bark-thickness serve to indicate the gross improvements produced by manuring, but they are not sufficiently closely correlated with yield for serving to distinguish between cases of restored rubber, that is, for comparing the relative powers of different fertilisers to increased production. (*R. L. S.*)

The relative values of organic and inorganic nitrogen fertilizers. A. H. Lewis, I. C. I. Agricultural Research Station, Jealott's Hill, Bracknell, Berks. (*Emp. J. Expt. Agric. Vol. VI, No. 21*).

The experimental work described consists of two parts. In the first part the results of a field experiment which was conducted at Datchet, Bucks, on the same site in 1934 and 1935 on alluvial soil in typical market garden conditions are described. The crop used in this experiment was Brussels sprouts. In the second the results of a parallel pot culture experiment which was conducted in glazed pots, using as growth medium a mixture of soil from the experimental field at Datchet and sand are given. White mustard (*Sinapis alba*) was used as the test plant in the first year, several immature crops being harvested to study uptake of nitrogen in the early stages of the experiment. Barley and wheat were used in the second and third years. The treatments were the same as in the field experiment with the addition of urea and ammonium nitrate. The term 'organic nitrogen fertilizers' in this experiment mean those materials of plant or animal origin which contain a fairly high proportion of plant nutrients and can thus be classified as fertilizers. Bulky organic materials of low

analysis such as farmyard manure, do not come in this category. The results of experiments to study the relative effects of organic and inorganic nitrogen fertilizers under these two conditions show that organic nitrogen fertilisers are not superior to inorganic nitrogen fertilizers in crop producing power. There is no evidence that organic nitrogen fertilizers have any value beyond that to total nitrogen content. The evidence shows that provided that the lime status of the soil is maintained at an adequate level, inorganic nitrogen fertilizers will give at least as good results as organic fertilizers supplying the same amounts of nitrogen.

The main claims of the superiority of organics in (1) the slow release of available nitrogen, (2) as a source of humus and thereby improving the physical condition of the soil and (3) containing specific beneficial substances, *e.g.*, hormones are explained in the discussion in the end as of no special advantages over the inorganics. (*R. L. S.*)

Experimental and statistical technique of some complex cotton experiments in Egypt. F. Crowther, and M. S. Bartless, Imperial Chemical Industries, Ltd. (*Emp. J. Expt. Agric. Vol. VI, No. 21*).

The experimental and statistical technique used in a series of complex cotton experiments carried out in Egypt during 1934-36 is discussed in relation both to the objects of the research programme and to the particular conditions determining field experimentation on the cotton crop in Egypt. The experiments were limited in the 1934 season to simultaneous comparison of the four factors, variety, spacing, nitrogen and water supply. In 1935 phosphate generally replaced water as the fourth factor. As the information from the experiments proved consistent, in 1936 the investigations were extended to include such factors as date of sowing and date of fertiliser application.

Statistical aspects of the results considered include figures on the relative accuracy of main and sub-plot or of partially confounded to completely randomized lay-outs; and the correction for damage due to salt accumulation in the upper layers of the soil for three of the 1936 experiments. The variation in fertility throughout the site in three representative experiments is illustrated. Salt accumulations in the upper layers of the soil can be very serious in Egypt owing to the harm done to the crop. Such salt accumulations are produced by inadequate drainage of sub-soil water, the salt moving upwards in the wet soil and accumulating on the ridge above the level reached by the irrigation water. If this accumulation is severe early in the season the young cotton plants die. The occurrence of salt is so wide-spread that any series of experiments if representative must include some experiments in which the yields of some plots are reduced by salt damage. The exact type of lay-out decided on is necessarily a problem demanding some deliberation depending both on practical and theoretical considerations. No lay-out, however, will eliminate the extreme patchiness and the need for care in the choice of an experimental site is indicated. (*R. L. S.*)

The following abstracts of articles from the *Indian Forester* have been received from the President, Forest Research Institute, Dehra Dun, and are published here as they are of interest to agricultural workers :—

Regeneration and propagation of sandalwood. S. Rangaswami. (*Ind. For.* XLIII (8) : 522-37, 1937).

Natural reproduction of sandal, general seasons of seeding and the seeding capacity have been discussed.

The causes for the absence of seedling growth in certain localities have been traced to seed destruction by various agencies especially rodents.

Natural spread of sandal in Salem North Division since 1869 has been worked out. The importance of seed selection by natural agencies such as birds, animals, etc., pointed out. Various artificial methods of sandal propagation have also been described and the merits of artificial regeneration from nursery-grown plants by different methods over direct sowings have been indicated. (*S. Rangaswami*)

Note on sandal growth in Coorg. J. E. M. Michell. (*Ind. For.* LXIII (9) : 583-87, 1937).

Of the sandal trees in Coorg, only 8 per cent are in the forest reserves, the remaining 92 per cent are in estates outside that have been subjected to frequent fires and damage by villagers. Yet recent enumeration figures indicate that many of the trees have managed to survive to over 15 in. girth and the possible explanation is that either natural regeneration is profuse or light fires stimulate growth. The argument that trees found in rich soils of the semi-ever-green type do not contain as much heartwood as those on poorer soils of the deciduous forests is open to question. Systematic tending and precautions against fire in dry weather might improve stocking in relatively good sandal areas. (*M. V. Laurie*)

Note on the comparative strengths of sapwood and heartwood. H. Trotter. (*Ind. For.* LXIII (9) : 598-600, 1937).

Shows that for all practical purposes the difference between the strengths of heartwood and sapwood is negligible. (*H. Trotter*)

Departmental collection of Kulu gum (*Sterculia urens*) in Damoh division. Kesar Singh. (*Ind. For.* LXIII (7) : 449-55, 1937.)

As a result of defective tapping resulting in a large number of trees being killed and of poor financial results, it was considered necessary to replace the lease system by departmental collection in January 1935.

In the year 1934-35, 297 maunds of gum was collected for Rs. 1,316. This quantity was sold for Rs. 3,165, giving a net profit of Rs. 1,849. In the year 1935-36, 1,604 maunds of Kulu gum was collected for Rs. 5,113 which was sold for Rs. 11,868, giving a profit of Rs. 6,755.

The most suitable dimensions of cuts are 6 inches by 18 inches, but this requires further investigation.

The average yield per tree comes to one seer (*i.e.*, 2·2 lbs.) per year. (*Kesar Singh*).

Seed origin and its importance in Indian forestry. M. V. LAURIE. (*Ind. For.* LXII (1) : 18-22, 1936).

THIS article, in reply to a previous article by K. D. Joshi, reviews investigations at present in progress in India with regard to seed origin. The present lack of control over the source of seed used in artificial regeneration work is emphasised and suggestions made for certifying the origin of all seed supplied departmentally. A classification of the different types of characters that may be inherited is given. Special mention is made of the effect of size of seed in teak and other species on germination and subsequent development. The question whether provincial seed testing stations could perform any useful function is discussed, and the impossibility of such stations exercising any check on the hereditary suitability of seed is mentioned. (*M. V. Laurie*)

Porcupine-proof fencing. E. C. MOBBS. (*Ind. For.* LXII (11) : plate 1; 676-81, 1936).

DESCRIBES experiments with different gauges, mesh, height and depth of burying or width of layering along the ground for wire netting fences against porcupines. Layering was found useless. A fence of 18 gauge, 1 inch mesh 4 feet wide fixed vertically with 1½ feet above ground is recommended. (*M. V. Laurie*)

Regeneration of frost-liable forests in the Central Provinces. K. P. SAGREIYA. (*Ind. For.* LXIII (9) : 578-79, 1937).

ON the presumption that frost-bite in plants is caused when temperature of the surrounding cold air falls below a certain level, the writer suggests a method of preventing frost by inducing circulation of the stagnant cold air by cutting a series of strips across the frost-liable depression running in the direction of the prevailing wind in the locality. (*K. P. Sagreiya*)

Results of coppicing, pollarding and pruning experiments to stimulate Strychnos nux-vomica fruit production. J. W Nicholson. (*Ind. For.* LXIII (9) : 588-97, 1937).

The yield of *kuchila* seed is proportionate to the size of the tree. (2) Coppicing or pollarding trees reduces the size of the tree and causes a loss in seed production which is never likely to be made up. Pruning has the same effect but to a lesser degree. (3) Coppicing very young trees may result ultimately in their acquiring crowns of fuller spread than if they were left to grow naturally, but trees tend to develop spreading crowns as soon as height growth starts falling off, artificial measures to promote crown spread are therefore not likely to be worthwhile. (4) The yield of seed from individual trees fluctuates remarkably from year to year. Drought or fire, especially the latter, cause a subsequent drop in yield. (*J. W. Nicholson*)

REVIEWS

Scientific Horticulture (Formerly the H. E. A. Year Book). The Journal of the Horticultural Education Association. Vol. VI 1938. (Price 4*s.* net, 4*s.* 6*d.* by post, obtainable from the Editor, Scientific Horticulture, South-Eastern Agricultural College, Wye, Kent, England.)

THIS volume, like its predecessors, is of a high standard and full of information. Pages 17 to 159 contain seventeen papers read at the Third Revision Course in Horticulture at the University of Reading from September 14 to 17, 1937. There are eight other papers of which three give a clear concise account of some scientific subject closely connected with horticulture. These are :—

External Organic Growth-promoting Substances and Green Plants by M. Thomas.

Boron Deficiency in Horticultural Crops : Recent Developments by A. W. Greenhil, and

Chromosomes and their Importance in Horticulture by F. W. Sansome.

The last-named will be specially useful to those who have read a little elementary genetics such as given in Punnet's "Mendelism". It is particularly worthy of notice by anyone who teaches plant genetics. Incidentally it may be remarked that all the worth-while teaching of plant genetics in India is done in certain of the agricultural colleges or in the Imperial Agricultural Research Institute. The Book Reviews and Notices at the end give a conspectus of some recent important horticultural literature. [W. B.]

Potash Deficiency Symptoms (Kennzeichen Des Kalimangels, Signes De Manque De Potasse). By PROFESSOR DR. AGR. H. C. OSKAR ECKSTEIN, ALBERT BRUNO and DR. J. W. TURRENTINE, with the collaboration of G. A. COWIE and DR. G. N. HOFFER, published by Verlagsgesellschaft Für Ackerbau M. B. H. Berlin, S.W. II, 2nd Edition, 1937. (Price not stated).

THIS sumptuous volume is written throughout in three languages and has nearly half its bulk taken up by beautifully coloured illustrations indicating visually the effects of lack of potash in certain crops. There are also various uncoloured photographs in the text and a diagram indicating in kilogrammes per hectare, the amount of plant food removed from the soil by average crops. There is a

foreword by M. Gabriel Bertrand, Member of the Academy of Sciences of France and of the Academy of Agriculture, who introduces the three main authors as follows :—

" Prof. Oskar Eckstein, formerly of the Faculties of Science of the Universities of Chicago and Peking, directs the scientific activities of the German Potash Syndicate. He is the author of numerous chemical and agricultural papers. His department edits the review ' Die Ernahrung der Pflanze ' and includes the unusually well equipped Agricultural Experiment Station at Berlin-Lichterfelde, both well known throughout the agricultural world.

M. Albert Bruno, Ingénieur Agronome, is the director of the Scientific and Agricultural Service of the Société Commerciale des Potasses d'Alsace. After twenty years of activity in the laboratories of the French Ministry of Agriculture, he was appointed to the post of Director of the Central Laboratory of this Ministry and was entrusted later with the supervision of the whole service. After the war Mr. Bruno devoted a great part of his energies to the reorganization of the official agricultural stations. In 1927 he was delegated by the Ministry of Agriculture to take over his present position with the French potash mines.

Dr. J. W. Turrentine was formerly in-charge of Potash Researches of the Bureau of Chemistry and Soils, United States Department of Agriculture. His book ' Potash ' published in 1926 gives a review of the world's potash situation at that time. The different groups engaged in the exploitation of American salt lakes and mineral deposits and in the importation of potash salts to the United States have recently founded a joint research and educational service under the name of American Potash Institute and Dr. J. W. Turrentine was selected as its president."

After the introduction, the first part of the book deals with general symptoms of potash deficiency, under which there are four sections :—

(1) External symptoms and modifications of the inner structure of the plant,

(2) secondary effects of potash deficiency,

(3) potash deficiency and the market value of crops,

(4) pathology of potash deficiency.

The second part deals with potash deficiency symptoms of various cultivated crops including—

(*a*) maize and other cereals,

(*b*) fruit trees,

(*c*) vines.

There is a useful bibliography of 209 titles.

There are persons both lay and scientific, who have a tendency to regard any publications connected with commercial companies producing or selling artificial manures as necessarily biased and therefore to be regarded as propaganda.

A scientist, at least, ought to be able to approach any statement of experimental results both critically and objectively and those who can do so will find in the volume under review a mine of information and a whole series of indications which will be of undoubted assistance to them in planning their own laboratory and field experiments.

There is still much to learn with regard to the role in plant life of even those chemical elements known to be of first importance and a summary like this book, particularly when reinforced by the admirably coloured plates, is a valuable synopsis of a great deal of carefully documented experience. [*W. B.*]

The Punjab Fruit Journal (Annual Number). Available from the Punjab Fruit Development Board Lyallpur. Price Re. 1 for casual purchaser and Rs. 2 for annual subscribers for this and other copies published during the year.

THE first Annual Number of the Punjab Fruit Journal which has just been published, is undoubtedly a valuable addition to the agricultural and horticultural literature of the country. It has an extra large number of articles of great interest both in the English and vernacular sections.

The English section, in addition to the usual interesting pages of news, comments and seasonal hints, contains no less than fifteen articles on some of the most interesting and vital aspects of the fruit industry of the country. Important among these are : Obstacles in the Fruit Preservation Industry, Cultivation of Apples and Cherries in the Simla Hills, Improvement of Mangoes in the Punjab, Canning of Fruit Juices, Cold Storage, Cultivation of some Minor Economic Crops like Coriander, Fennel (*sonf*), *Ajwain*, Dill, Henbane, Rosha grass, Liquorice (*mulathi*) Isabgol, etc., and a large number of extracts and abstracts from leading foreign periodicals. A comprehensive fruit marketing scheme for improving the marketing of fruits is yet another valuable contribution to this issue.

The Urdu section has also been specially enlarged and contains about forty pages comprising of articles such as commercial aspect of fruit gardening, seasonal hints, a general horticultural guide, propagation of mangoes, and several other important articles on the control of diseases and pests of fruit trees. A comprehensive resume of results of experiments conducted on citrus fruits in the Punjab of over ten pages under the joint authorship of the Fruit Specialist and the Assistant Fruit Specialist, Punjab, is a special feature of this section.

NEW BOOKS

On Agriculture and Allied Subjects

The Microscope : Theory and Practice. By Conrad Beck. (London : R. and J. Beck, Ltd., 1938.) Price 7*s*. 6*d*. net.

Entomologie. 8vo. By W. Speyer. (Dresden und Leipzig : Theodor Steinkopff, 1937.) Price 13 gold marks.

The Observer's Book of Trees and Shrubs of the British Isles compiled by W. J. Stokoe. (London, New York : Frederick Warne and Co., Ltd., 1938.) Price 2*s*. 6*d*. net.

Marine Algae of the North-eastern Coast of North America. By William Randolph Taylor. (University of Michigan Studies, Scientific Series, Vol. 13, Ann. Arbor. Mich. : University of Michigan Press, 1937.) Price $5.

The Practical Book of Garden Structure and Design. By Harold D. Eberlein and C. Van Dyke Hubbard. (Philadelphia and London : J. B. Lippincott Co., 1938). Price 21*s*. net.

Plants for the Connoisseur. By Thomas Hay. (New York and London : Putman and Co., Inc., 1938). Price 10*s*. 6*d*. net.

Mother Earth : being Letters on Soil addressed to Prof. R. G. Stapledon. By Gilbert Wooding Robinson. (London : Thomas Murby and Co., 1937). Price 5*s*. 6*d*. net.

A B C of Agrobiology : the Quantitative Science of Plant Life and Plant Nutrition, for Gardeners, Farmers and General Readers. By O. W. Willcox. (London : George Allen and Unwin, Ltd., 1938.) Price 12*s*. 6*d*. net.

Phytohormones. By F. W. Went, Ph.D., Professor of Plant Physiology, California Institute of Technology and K. V. Thimann, Ph.D., Assistant Professor of Plant Physiology, Harvard University. (London W. C. 2: MacMillan & Co., Ltd.) Price 17*s*. net.

Perspectives in Biochemistry, edited by Joseph Needham and David E. Green. (Cambridge University Press). Price 15*s*. net.

Recent Advances in Entomology. By A. D. Imms, D.Sc., F.R.S., Reader in Entomology, University of Cambridge. (London W. 1 : J. & A. Churchill, Ltd., 104, Gloucester Place). Price 15*s*.

Vaccine and Serum Therapy. By A. Fleming, M.B., F.R.C.S., and G. F. Petrie, M.D., Ch.B. (London, W. 1 : J. & A. Churchill, Ltd., 104, Gloucester Place.) Price 15*s*.

Disorders of the Blood. (Second edition). By L. E. H. Whitby, C.V.O., M.D., F.R.C.P., and C. J. C. Britton, M.D., N.Z. (London, W. 1 : J. & A. Churchill, Ltd., 104, Gloucester Place.) Price 21*s*.

Muir-Bacteriological Atlas. Enlarged and rewritten by C. E. Van Rooyen, M.D. (Calcutta : Messrs. Butterworth & Co. (India), Ltd., Avenue House, Chowringhee Square, P. B. No. 251, 1937.) Price Rs. 10 net.

Animals and Men. By David Katz. (London, E. C. 4 : Longmans, Green and Co., Ltd., 39, Paternoster Row). Price 2*s*. 6*d*. net.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

British India

Notification No. F. 408-36-A, dated the 18th March 1938, issued by the Government of India in the Department of Education, Health and Lands.

In exercise of the powers conferred by sub-section (1) of section 3 of the Destructive Insects and Pests Act, 1914 (II of 1914), the Central Government is pleased to direct that the following further amendment shall be made in the Order published with the notification of the Government of India in the Department of Education, Health and Lands, No. F. 320/35-A, dated the 20th July 1936, namely :—

In clause (*a*) of rule 11 of the said Order, for the words " otherwise than by sea " the words " or otherwise than by sea " shall be substituted.

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Plant Quarantine Regulations and Import Restrictions relating to the following countries have been received in the Imperial Council of Agricultural Research. Those interested are advised to apply to the Secretary, Imperial Council of Agricultural Research, for full particulars.

United States of America

1. Modification of Pink Bollworm Quarantine Regulations.
2. Mexican Fruitfly Quarantine.
3. Black Stem Rust Quarantine.
4. Modification of Dutch Elms Quarantine Regulations.
5. Service and Regulatory Announcements, July-September 1937.
6. Modification of Cotton Regulations.

Uganda Protectorate

7. Plant Protection Ordinance (1937).

Yugoslavia

8. Plant Quarantine Regulations.

Summaries issued of Plant Quarantine Import Restrictions by the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine of :—

9. The Kingdom of Iraq.

10. The Presidency of St. Christopher and Nevis, Branch West Indies.

11. The Australian Territory of Papua.

12. Iran (Persia).

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

THE names of the following recipients of His Majesty the King Emperor's Birth-day Honours will be of interest to the Agricultural and Veterinary Departments in India :—

O. B. E. : DR. NAZIR AHMAD, Ph.D. (Cantab.), F. Inst. P., Director Technological Laboratory, Matunga, Bombay.

M. B. E. : HIRA LALL DUTTA, Provincial Agricultural Service, Deputy Director of Agriculture, Orissa.

M. B. E. : Mr. M. R. KRISHNASWAMI AYYAR RAMAYYA, Paddy Specialist at the Agricultural College and Research Institute, Coimbatore, Madras.

Rao Bahadur : RAO SAHIB BHASKAR PARASHRAM VAGHOLKAR, L. Ag., Principal Agricultural Officer, Sugarcane Research Scheme, Padegaon, Poona District, Bombay.

Rao Sahib : CHAUDHRI RAM DHAN SINGH, Punjab Agricultural Service, Cerealist, Lyallpur, Punjab.

Imperial Council of Agricultural Research

COLONEL SIR ARTHUR OLVER, C.B., C.M.G., F.R.C.V.S., F.N.I., Animal Husbandry Expert, Imperial Council of Agricultural Research, has been granted leave on average pay for eight months combined with leave on half average pay for two days, with effect from the 7th May, 1938 or subsequent date, preparatory to retirement.

MR. F. WARE, C.I.E., F.R.C.V.S., I.V.S., Director, Imperial Veterinary Research Institute, Mukteswar, has been appointed to officiate as Animal Husbandry Expert, Imperial Council of Agricultural Research, with effect from the date of assuming charge and until further orders.

DR. W. BURNS, D.Sc., I.A.S., Officiating Agricultural Expert, Imperial Council of Agricultural Research, has been granted leave on average pay for two months and twenty-seven days combined with leave on half average pay for seventeen days with effect from the 3rd June 1938.

MR. H. R. STEWART, I.A.S., Director of Agriculture, Punjab, has been appointed to officiate as Agricultural Expert, Imperial Council of Agricultural Research, with effect from the 3rd June 1938, *vice* DR. W. BURNS, granted leave.

MR. SUBIMAL DUTT, I.C.S., has been appointed Under Secretary to the Government of India in the Imperial Council of Agricultural Research Department, with effect from the 8th March 1938, until further orders.

MR. A. MCD. LIVINGSTONE, M.C., M.A., B.Sc., Agricultural Marketing Adviser to the Government of India, has been granted leave on average pay for three months and fifteen days with effect from the 3rd June 1938, with permission to suffix Sunday the 18th September 1938.

MR. D. R. SETHI, M.A., B.Sc. (Edin.), I.A.S., Director of Agriculture, Bihar, has been appointed to officiate as Agricultural Marketing Adviser to the Government of India, with effect from the 3rd June 1938, *vice* MR. A. MCD. LIVINGSTONE, granted leave.

MR. A. WILSON, M.A., B.Sc., I.A.S., Special Officer, Cinchona Enquiry, Imperial Council of Agricultural Research, has been granted leave on average pay for eighteen days from the 3rd January 1938 and on half average pay for one month and four days in continuation thereof.

MR. TRIYUGI PRASAD, M.A., LL.B., Assistant Marketing Officer (Central Service, Class II), has been appointed Marketing Officer for Sugar (Temporary) with effect from the 1st December 1937.

Indian Central Cotton Committee

The Governor-General in Council has been pleased to reappoint DIWAN BAHADUR SIR T. VIJAYARAGHAVACHARYA, K.B.E., to be a member of the Indian Central Cotton Committee.

The Governor-General in Council has been pleased to reappoint LALA SHRI RAM as an additional member of the Indian Central Cotton Committee, to represent the Cotton Mill Owners of Delhi.

MR. A. P. DARLOW, of Messrs. Gill and Company, Ballard Estate, Bombay, has been nominated by the Karachi Chamber of Commerce to be a member of the Indian Central Cotton Committee, Bombay, *vice* MR. G. C. R. COLERIDGE, resigned.

In consequence of vacancies caused by the retirement of nominated members from the 1st April 1938, the following have been nominated to be members of the Indian Central Cotton Committee, Bombay :—

By the Bombay Chamber of Commerce

1. MR. M. S. DURUTTI.

By the Tuticorin Chamber of Commerce

2. MR. J. VONESH.

By the Central Government

3. MR. H. SITARAMAN REDDI GARU, M.L.A., Vakil, Bellary, to represent the Cotton Growing Industry in the Madras Presidency.

By the Upper India Chamber of Commerce

4. MR. J. TINKER.

Imperial Agricultural Research Institute

RAO BAHADUR T. S. VENKATRAMAN, C.I.E., B.A., I.A.S., Sugarcane Expert, Coimbatore, has been granted leave on average pay for one month and fifteen days from the 20th April 1938.

MR. N. L. DUTT, M.Sc., Second Cane-breeding Officer, Coimbatore, has been appointed to officiate as Sugarcane Expert in addition to his own duties, during the absence on leave of RAO BAHADUR VENKATRAMAN.

Imperial Veterinary Research Institute

The services of MR. W. TAYLOR, D.V.H., M.R.C.V.S., I.V.S., have been re-placed at the disposal of the Government of the Punjab with effect from the after-noon of the 12th March 1938.

MR. RIAZUL HASSAN, B.A., M.R.C.V.S., L.M., Officer in-charge, Biological Products Section, Imperial Veterinary Research Institute, Izatnagar, was appoint-ed to hold charge of the post of Director, Imperial Veterinary Research Institute, in addition to his own duties with effect from the 12th March 1938, until the return of MR. F. WARE.

On return from leave MR. J. F. SHIRLAW, M.R.C.V.S., was appointed tem-porary Veterinary Research Officer in-charge of Serology with effect from the 1st March 1938, until MR. J. R. HADDOW's return.

The services of DR. PURNENDU SEN, M.Sc., PH.D., Officiating Entomologist, Imperial Veterinary Research Institute, Mukteswar, have been replaced at the disposal of the Government of Bengal, with effect from the 26th March 1938.

Imperial Dairy Institute

MR. S. COX, Superintendent, Imperial Dairy Institute, Bangalore, has been granted leave on average pay for eight months out of India, with effect from the 20th April 1938.

MR. M. C. RANGASWAMY, I.D.D., N.D.D. (Scot.), Supervisor in-charge, Wellington Milk Depot, has been appointed to officiate as Superintendent, Im-perial Dairy Institute, Bangalore, with effect from the 20th April 1938, *vice* MR. COX, granted leave.

Madras

The Government accept the resignation tendered by MR. N. G. CHARLEY, B.E., of the post of Research Engineer, Coimbatore, with effect from the 28th April 1938.

MR. SAADAT-UL-LAH KHAN, M.A. (Oxon.), Bar.-at-Law, I.A.S., Deputy Director of Agriculture, IV Circle, St. Thomas' Mount, has been granted leave on average pay for one month and twelve days from 1st March 1938.

MR. K. RAGHAVA ACHARYA, Assistant Director of Agriculture, Cuddalore, has been appointed to be in full additional charge of the duties of the Deputy Director of Agriculture, IV Circle, during the absence on leave of MR. SAADAT-ULLAH KHAN.

MR. PAUL D. KARUNAKAR, B.Sc. (Iowa), M.Sc. (New Jersey), Agricultural Bacteriologist, has been granted an extension of leave for three months, with effect from the 1st March 1938.

MR. M. SANYASI RAJU GARU, Assistant in Bacteriology, has been appointed as Officiating Agricultural Bacteriologist, Coimbatore, from date of taking charge, *vice* MR. PAUL D. KARUNAKAR, applied for extension of leave.

Bengal

MR. A. D. MACGREGOR, F.R.C.V.S., F.Z.S., Principal, Bengal Veterinary College, has been appointed to be Veterinary Adviser to the Government of Bengal, in addition to his own duties, during the absence on leave of MR. P. J. KERR, or until further orders.

RAI SAHIB MOKSHADA PROSAD GHOSH, G.B.V.C., Assistant Director, Civil Veterinary Department, Eastern Range, has been appointed to officiate as Director, Civil Veterinary Department, Bengal, in the Bengal Higher Veterinary Service, during the absence, on leave, of Mr. P. J. KERR, or until further orders.

MR. HEM CHANDRA DAS GUPTA, Inspector, Civil Veterinary Department, has been appointed to act as Assistant Director, Civil Veterinary Department, Eastern Range, *vice* RAI SAHIB MOKSHADA PROSAD GHOSH, appointed to act as Director, Civil Veterinary Department, Bengal.

MR. W. M. CLARK, M.B.E., B.Sc., I.A.S., Deputy Director of Agriculture, Burma, has been appointed to act as Deputy Director of Agriculture, Eastern Circle, Bengal, with effect from the 10th February 1938, *vice* MR. P. C. CHAUDHURY, appointed to act as Assistant Director of Agriculture.

RAI SAHIB NRIPENDRA NATH MAZUMDAR, G.B.V.C., Assistant Director, Civil Veterinary Department, Western Range, has been granted leave for the period from the 25th March 1938 to the 30th June 1938, preparatory to retirement.

MR. BHUPENDRA NATH DAS GUPTA, Inspector, Civil Veterinary Department, has been appointed to act as Assistant Director, Civil Veterinary Department, Western Range, during the absence, on leave, of RAI SAHIB NRIPENDRA NATH MAZUMDAR, or until further orders.

RAI SAHIB CHUNILAL MUSTAFI, Chief Superintendent, Dacca Farm, has been appointed to act as Deputy Director of Agriculture, Western Circle, with effect from 1st May 1938, *vice* MR. J. N. SIRKAR, deceased.

MR. GOSHTHA BIHARI PAL, M.Sc., Agricultural Chemist, Bengal, has been granted leave on average pay for two months, with effect from the 3rd May 1938.

United Provinces

MR. C. H. PARR, I.A.S., Deputy Director of Agriculture, Bundelkhand Circle, Jhansi, has been granted leave on average pay for a period of five months and on half average pay for one month, with effect from the 1st April 1938, or subsequent date of relief.

MR. T. R. LOW, I.A.S., on foreign service as Director, Institute of Plant Industry, Indore, has been granted leave out of India, on full average pay for three months combined with leave on half average pay for four months and five days, with effect from the 25th March 1938, or date of relief.

MR. MAQSUD ULLAH S. JUNG, Dip. Agri., Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly, has been transferred to Bundelkhand Circle, Jhansi, in the same capacity.

MR. S. C. ROY, M.Sc., Assistant Director of Agriculture, at present working as Cane Development Officer, Eastern Range, Gorakhpur, has been appointed to officiate as Deputy Director of Agriculture, *vice* Mr. C. H. PARR, I.A.S., granted leave, but to hold charge of the Rohilkhand and Kumaun Circle.

Punjab

MR. W. TAYLOR, M.R.C.V.S., D.V.H., I.V.S., on reversion from the post of Director, Imperial Veterinary Research Institute, Mukteswar, has resumed charge of his appointment as Principal and Professor of Medicine, Punjab Veterinary College, Lahore, with effect from the 14th March 1938, relieving CAPTAIN U. W. F. WALKER, M.C., M.R.C.V.S., I.V.S., of the additional charge of Principal and MR. SETH MOHAMMAD SARWAR, M.R.C.V.S., of the duties of the post of Professor of Medicine.

On return from leave MR. DARSHAN SINGH, Bar.-at-Law, M.R.A.C., F.R.H.S., M.R.A.S., I.A.S., resumed charge of his appointment as Deputy Director of Agriculture, Gurdaspur, with effect from the 3rd February 1938, relieving MR. H. G SADIK, who reverted to the post of Extra Assistant Director of Agriculture.

KHAN BAHADUR M. FATEH-UD-DIN, M.B.E., I.A.S., Deputy Director of Agriculture, Jullundur, has been transferred temporarily to foreign service out of India as Agricultural Expert Adviser to the Government of Bahrain, from the 21st February 1938.

MR. H. G. SADIK, B.A. (Oxon.), Extra Assistant Director of Agriculture, Jullundur, has been appointed Officiating Deputy Director of Agriculture, Jullundur, with effect from the 21st February 1938, *vice* KHAN BAHADUR M. FATEH-UD-DIN, M.B.E., I.A.S., transferred temporarily to foreign service under the Bahrain Government.

KHAN SAHIB AGHA YUSAF ALI KHAN, Deputy Director of Agriculture, Montgomery, has been granted leave on average pay for four months, with effect from the 4th March 1938.

MALIK SULTAN ALI, I.A.S., Deputy Director of Agriculture, has been transferred to Montgomery, with effect from the 4th March 1938, relieving KHAN SAHIB AGHA YUSAF ALI KHAN, granted leave.

The services of DR. S. V. DESAI, B.Sc., Ph.D. (Lond.), D.I.C. (Lond.), Agricultural Bacteriologist, Lyallpur, on probation, have been replaced at the disposal of the Government of India in the Department of Imperial Council of Agricultural Research, with effect from the 8th March 1938, and he reverted to his substantive appointment in the Imperial Agricultural Research Institute, New Delhi.

Central Provinces and Berar

MR. J. S. GAREWAL, M.R.C.V.S., I.V.S., Officiating Director of Veterinary Services, Central Provinces and Berar, reverts to the Government of the Punjab, with effect from the date on which he makes over charge of his duties.

MR. J. C. MCDOUGALL, M.A., B.Sc. (Edin.), Director of Agriculture, Central Provinces and Berar, has been appointed to hold charge of the office of the Director of Veterinary Services, Central Provinces and Berar, in addition to his own duties, *vice* Mr. J. S. GAREWAL, reverting to the Punjab, or until further orders.

MR. R. H. HILL, M.A. (Cantab.), Deputy Director of Agriculture, Economics and Marketing, Central Provinces and Berar, has been granted leave on average pay for six months and leave on half average pay for two months, with effect from the 17th March 1938, or such subsequent date on which he takes it.

MR. P. D. NAIR, M.A., L.Ag. (Hons.), Post-graduate (Pusa), Assistant Director of Agriculture, attached to the office of Director of Agriculture, Central Provinces and Berar, has been appointed to officiate as Deputy Director of Agriculture, Economics and Marketing, *vice* MR. R. H. HILL, proceeding on leave or until further orders.

Mr. P. S. Nair, G.B.V.C., Assistant Director of Veterinary Services, Nagpur Division, has been granted leave on average pay for two months, with effect from the date on which he avails himself of it.

Mr. S. S. Ayer, G.B.V.C., Senior Veterinary Inspector, Gondia, has been appointed to Officiate as Assistant Director of Veterinary Services, Nagpur Division, *vice* Mr. P. S. Nair, granted leave or until further orders.

Mr. J. F. Dastur, M.Sc., D.I.C., Mycologist to Government, Central Provinces and Berar, has been granted leave on average pay for two months and six days, with effect from the 25th April 1938.

Bihar

Major P. B. Riley, M.R.C.V.S., I.V.S., Director, Veterinary Services, Bihar, has been granted leave on average pay for five months and twenty days and leave on half average pay for one year, eight months and ten days, with effect from the 1st April 1938, preparatory to retirement.

Mr. Muhammad Ismail Malik, M.R.C.V.S. Officiating Principal of the Bihar Veterinary College, Patna, has been appointed to act as the Director, Veterinary Services, Bihar, with effect from the 1st April 1938, during the absence, on leave of Major P. B. Riley, I.V.S., or until further orders.

Mr. Muhammad Ismail Malik will, in addition to his own duties as Officiating Director, Veterinary Services, hold charge of the current duties of the Principal of the Bihar Veterinary College, with effect from the 1st April 1938, until further orders.

Maulvi Muhammadi Khan, Assistant Director of Agriculture, Pusa, has been granted leave on average pay for two months, with effect from the 4th April 1938 or any subsequent date from which he avails himself of it.

DR. HARENDRA NATH MUKHERJEE, Senior Scientific Assistant, Chemical Section, has been appointed to act as Agricultural Chemist, *vice* DR. T. J. MIRCHANDANI, deputed on foreign service, with effect from the afternoon of the 2nd November 1937. His headquarters will be at Sabour in the district of Bhagalpur.

Orissa

MR. NILAMANI CHATTERJI, G.B.V.C., Assistant Director of Veterinary Services, Orissa, has been vested with all the powers of a Deputy Director of Veterinary Services, in the districts of Ganjam (excluding the Khondmals) and Koraput, with effect from the 1st October 1937.

RAI SAHIB JAGANNATH DE, a retired Government servant of the Agricultural Department, has been reappointed to act as Assistant Director of Agriculture, Orissa, with effect from the 3rd March 1938, until further orders.

MR. P. S. KUPPUSWAMI has been appointed temporarily as the Veterinary Investigation Officer for Orissa, with effect from the date he joins the appointment.

North-West Frontier Province

LIEUTENANT-COLONEL E. W. C. NOEL, C.I.E., D.S.O., of the Indian Political Department, relinquished charge of the Office of Director of Agriculture and Allied Departments, North-West Frontier Province, with effect from the forenoon of the 1st March 1938.

Sind

The Governor of Sind has been pleased to appoint RAO BAHADUR V. R. PHADKE, G.B.V.C., J.P., late Principal of the Bombay Veterinary College, Bombay Presidency to act as Director of Veterinary Services, Sind, *vice* MR. J. H. G. [illegible], M.R.C.V.S., I.V.S., proceeding on leave for six months, with effect from the 9th May 1938.

Burma

Mr. A. McLean, I.A.S., Deputy Director of Agriculture, East Central Circle, has been transferred to Mandalay as Principal, Agricultural College, Mandalay, in place of Mr. D. Rhind, who remains as Economic Botanist with headquarters at Mandalay.

The services of Mr. W. M. Clark, M.B.E., B.Sc., I.A.S., are placed permanently at the disposal of the Government of Bengal, with effect from the 4th February 1938.

U Thet Su, D.I.C., B.Ag., Mycologist, has been posted as Deputy Director of Agriculture, East Central Circle, with headquarters at Pyinmana in place of Mr. A. McLean, transferred.

Dr. A. T. Sen, M.Sc., Ph.D., A.I.C., Agricultural Chemist, has been, on return from leave, reposted as Agricultural Chemist with headquarters at Mandalay.

Recent Publications of the Imperial Agricultural Bureaux

I. Obtainable from the Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden, Herts

Periodical Abstracts

	s.	d.
List of publications and papers on Soil Science published in the Empire Overseas in—		
1933	1	0
1934	1	0
Soil Research in the British Empire published in 1935	1	0
Lists of Publications relating to Soils and Fertilisers—		
Published monthly, per annum, post free	10	0
Monthly Letters—		
Free to recipients, within the British Empire, of "Publications relating to Soils and Fertilisers". Subscription, outside the Empire, per annum	4	0
Recent Developments in Soil Analysis—		
Quarterly Supplement to the above publications. Separate copies, each	0	6

Occasional Papers

	s.	d.
Technical Communications—		
34. Tropical Soils in relation to Tropical Crops	2	6
Annual Report : For the year 1933-34	0	6
" 1934-35	0	6
" 1935-36	0	6
Bibliographies—		
Bibliography on Coffee	2	0
Catalogue of Journals and Periodicals in the Library of Rothamsted Experimental Station	2	0
Special Publication—		
The Katamorphism of Igneous Rocks under Humid Tropical Conditions (by the late Sir J. B. Harrison)	5	0
Bibliography of Soil Science, Fertilizers and General Agronomy, 1931-34	25	0

II. Obtainable from the Imperial Bureau of Animal Health, Veterinary Research Laboratory, New Haw, Weybridge, Surrey

Abstracting Journal

	s.	d.
The Veterinary Bulletin—		
1931. Vol. 1. Quarterly (1st Number, April)	7	6
Annual subscription	20	0
Subsequent volumes. Monthly (1st Number, January)	5	0
Annual subscription (postage paid)	40	0

		s.	d.
	Indexing Publication		
Index Veterinarius.—Four issues a year. First issue, April 1933. Annual subscription (postage paid). Volumes I to III mimeographed, Volume IV onwards printed		100	0

III. Obtainable from the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Bucksburn, Aberdeen

	Journal		
Nutrition Abstracts and Reviews. (Issued under the direction of the Imperial Agricultural Bureaux Council, the Medical Research Council and the Reid Library)—			
Subscription per volume of 4 numbers		42	0
Per single number		13	0
	Occasional Papers		
Technical Communications—			
6. The Composition of Certain African Foods and Feeding Stuffs		1	0
7. Wheat. Pre-eminence as a Cereal Food: Nutritive Value; Relation to Health and Disease		1	0
Occasional Communications—			
1. The Effect of Climate on the Composition of Pasture Plants		..	

IV. Obtainable from the Imperial Bureau of Plant Breeding and Genetics Plant Breeding Institute, School of Agriculture, Cambridge

	Journal		
Plant Breeding Abstracts—			
Quarterly. Annual subscription		15	0
Single copy		5	0
	Occasional Papers		
Indexes to Plant Breeding Abstracts—			
Subject Index to Vols. I to V of Plant Breeding Abstracts		5	0
Subject Index to Vol. VI of Plant Breeding Abstracts		2	6
Supplements to Plant Breeding Abstracts—			
Summary of Reports received from Countries exclusive of the British Empire, 1928-31. Supplement I		0	6
Summary of Reports received from Stations in the British Empire, 1932-35. Supplement II		5	0
Technical Communications—			
Vernalization and Phasic Development of Plants, 1935 (Joint Publication of the Imperial Bureaux of Plant Genetics)		10	0
The South American Potatoes and their Breeding Value		3	6
Bibliographical Monographs—			
Breeding Resistant Varieties, 1930-33 (Supplement)		2	0
The Experimental Production of Haploids and Polyploids		5	0

V. OBTAINABLE FROM THE IMPERIAL BUREAU OF PASTURES AND FORAGE CROPS, WELSH PLANT BREEDING STATION, AGRICULTURAL BUILDINGS, ALEXANDRA ROAD, ABERYSTWYTH, WALES

Journals

	s.	d.
Herbage Abstracts—		
Quarterly. Annual subscription	15	0
Single number	5	0

Herbage Reviews—

Subscription is at present—Vol. 1 (1933), Vol. 2 (1934), Vol. 3 (1935), Vol. 4 (1936)—included in that to Herbage Abstracts.

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18. Pastures and Forage Crops in South Africa	3	0
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22. Technique of Grass Seed Production at the Welsh Plant Breeding Station	5	0
23. Production of Legume Seed	5	0
24. Collection of Native Grass Seed in the Great Plains, U. S. A.	2	0

VI. OBTAINABLE FROM THE IMPERIAL BUREAU OF HORTICULTURE AND PLANTATION CROPS, EAST MALLING RESEARCH STATION, EAST MALLING, KENT

Journal

Horticultural Abstracts—

A quarterly abstract publication of current horticultural literature—

	s.	d.
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	s.	d.
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8. Horticultural Aspects of Woolly Aphis Control together with a Survey of the Literature, 1936. R. M. Greenslade	2	6

Occasional Papers

	s.	d.
3. Annotated Bibliography on Bitter-Pit, 1934	1	6
4. Recent Work of Tropical and Sub-tropical Interest	0	6

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Other Publications—

Index to Volumes I-X of the *Journal of Pomology and Horticultural Science*, 1933. Compiled by Bureau, published by the Editors of the *Journal of Pomology and Horticultural Science*. Available from the Bureau 5 0

Old and New Standpoints on Senile Degeneration, 1931. A. P. C. Bijhouwer 0 6

Fruit Growing in the Empire. Standardisation of Horticultural Material with special reference to Rootstocks, 1927. R. G. Hatton. Being unnumbered Empire Marketing Board Publication. (Free).

Viticultural Research, 1928. D. Akenhead. Being Empire Marketing Board Publication 11 . . . . 1 0

VII. Obtainable from the Imperial Bureau of Animal Breeding and Genetics, Institute of Animal Genetics, University of Edinburgh, King's Buildings, West Mains Road, Edinburgh

Journal

Animal Breeding Abstracts (quarterly), commencing April, 1933. Annual subscription 15 0

Occasional Papers

Bibliography of the Works of J. C. Ewart (free to subscribers of Animal Breeding Abstracts, Vol. 1), 1934 . . . . 0 6

Animal Breeding in the British Empire. A Survey of Research and Experiment, 1934 . . . . 2 0

VIII. Obtainable from the Imperial Bureau of Agricultural Parasitology (Helminthology), Institute of Agricultural Parasitology, Winches Farm Drive, Hatfield Road, St. Albans, Herts

Journal

Bibliography of Helminthology. For the year 1933—

Library Edition, bound in cloth 10 6

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Helminthological Abstracts (1932 onwards). Issued in five or six parts per volume, each volume covering the literature of a single year. Subscription per volume, payable in advance 30 0

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Occasional Papers

(*i*) The Effects of some Natural Factors on the Second Ecdysis of Nematode Infective Larvae. G. Lapage 4 0

Notes and Memoranda—

11. Recent Developments in the Control of *Heterodera marioni* . . 1 6

PUBLICATIONS ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY, 41 QUEEN'S GATE, LONDON S. W. 7

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PUBLICATIONS OBTAINABLE FROM THE IMPERIAL MYCOLOGICAL INSTITUTE, KEW, SURREY

Journal

Review of Applied Mycology—	
Annual subscription, 12 monthly parts, with title-page and index (post free)	21 0
Single part	2 0
Title-page and index	3 0
Report on the Third Imperial Mycological Conference, 1934 . . .	2 0

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(Prices are inclusive of packing and Indian postage)

1. Agriculture and Live-stock in India

ICAR. 1. A bi-monthly journal of agriculture and animal husbandry for the general reader interested in agriculture or live-stock in India or the Tropics (Established 1931. Published in January, March, May, July, September and November. Prepayable subscription Rs. 6 or 9*s*. 9*d*. per annum. Price per part Rs. 2 or 3*s*. 6*d*.) Volumes I to VII complete are available.

2. The Indian Journal of Agricultural Science

ICAR. 5. A bi-monthly scientific journal of agriculture and the allied sciences, mainly devoted to the publication of the results of original research and field experiments. (Established 1931. Published in February, April, June, August, October and December. Prepayable subscription Rs. 15 or 24*s*. per annum. Price per part Rs. 3 or 5*s*. 3*d*.) Volumes I to VII complete are available.

3. The Indian Journal of Veterinary Science and Animal Husbandry

ICAR. 6. A quarterly journal for the publication of scientific matter relating to the health, nutrition and breeding of live-stock. (Established 1931. Published in March, June, September and December. Prepayable subscription Rs. 6 or 9*s*. 9*d*. Price per part Rs. 2 or 3*s*. 6*d*.) Volumes I to VII complete are available.

4. Scientific Monographs of the Imperial Council of Agricultural Research

ICAR. 10·1. No. 1. The Fungi of India. By E. J. Butler, C.I.E., D.Sc., M.B., F.R.S. and G. R. Bisby, Ph.D. (1931). Price Rs. 6-12-0 or 11*s*.

ICAR. 10·2. No. 2. Life-histories of Indian Microlepidoptera, Second Series : Alucitidae (Peterophoridæ, Tortricina and Gelechiadæ). By T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S. (1932). Price Rs. 3-4-0 or 5*s*. 6*d*.

ICAR. 10·3. No. 3. The Open Pan System of White-Sugar Manufacture. By R. C. Srivastava, B. Sc. (1935, 2nd edition.) Price Rs. 3-2-0 or 5*s*. 6*d*.

ICAR. 10·4. No. 4. Life-histories of Indian Microlepidoptera : Cosompterygidæ to Neopseustidae. By T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S. (1933). Price Rs. 4-8-0 or 7*s*. 6*d*.

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ICAR. 10·6. No. 6. Helminth Parasites of the Domesticated Animals in India. By G. D. Bhalerao, M.Sc. (1935). Price Rs. 7-12-0 or 13*s*. 3*d*.

ICAR. 10·7.	No. 7. Influence of Manures on the Wilt Disease of *Cajanus indicus* Spreng. and the Isolation of Types Resistant to the Diseases. By W. McRae, M.A., D.Sc. (Edin.), F.L.S. and F. J. F. Shaw, D.Sc. (Lond.), A.R.C.S., F.L.S. (1933). Price Rs. 2-4-0 or 4*s*. 3*d*.
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ICAR. 10·11.	No. 11. Investigations on the Course and Distribution of the Nerves supplying Levator anguli scapuli and Rhomboideus muscles and the Formation of the Phrenic Nerve in the Ox, with Observations on certain Anatomical Deviations. By H. N. Chelva Ayyangar, G.M.V.C. (1937). Price Rs. 4-10 or 7*s*. 9*d*.
ICAR. 10·12.	No. 12. The Fungi of India. Supplement I. By B. B. Mundkur (In the Press).

5. Miscellaneous Bulletins of the Imperial Council of Agricultural Research

ICAR. 8·1.	No. 1. List of Publications on Indian Entomology, 1930. Compiled by the Imperial Entomologist, Pusa. (1934). Price As. 14 or 1*s*. 6*d*.
ICAR. 8·2.	No. 2. List of Publications on Indian Entomology, 1931. Compiled by the Imperial Entomologist, Pusa. (1934). Price As. 8 or 10*d*.
ICAR. 8·3.	No. 3. List of Publications on Indian Entomology, 1932. Compiled by the Imperial Entomologist, Pusa. (1934). Price As. 12 or 1*s*. 3*d*.
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ICAR. 8·5.	No. 5. List of Publications on Indian Entomology, 1933. Compiled by the Officiating Imperial Entomologist, Pusa. (1935). Price As. 9 or 1*s*.
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ICAR. 8·10.	No. 10. Diseases of Sugarcane and Methods for their Control. By L. S. Subramaniam. (1936). Price Rs. 1-14 or 3*s*. 3*d*.
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Agriculture & Live-stock in India

Vol. VIII, Part V, September 1938

EDITORIAL

MODERN TRENDS IN VETERINARY EDUCATION

In another part of this number will be found a somewhat detailed description of a recent visit to some of the German Veterinary Colleges and this seems, therefore, to be a suitable opportunity to examine the present trend of veterinary education, so that those concerned with this subject in India may be in a position to apply the latest developments to the best advantage of this country.

The outstanding feature of the German colleges is the comprehensive character of the course, which provides the student with a thorough training in all branches of animal health. The different subjects are grouped together in appropriate Institutes or Sections, each under a separate head and each self-contained in the matter of lecture rooms, practical class-rooms, museum, library, and those appendages which are needed for teaching the practical side of the subject concerned, such as an aquarium, a herd of dairy animals, sick wards, etc.

The question whether veterinary colleges are successfully fulfilling their duties or whether, in order to meet present-day requirements, a re-orientation of their curriculum is necessary has recently been the subject of enquiry in other countries. Speaking generally, the present demand is for a graduate versed not so much in the science of curative medicine and

surgery but in preventive medicine, using the term in its widest sense. The veterinary graduate of the future, therefore, should be a man brought up amongst animals in health, with the knowledge of how to maintain them in the fullest health, and not merely one to be called in when an animal has fallen sick. In this connection it is of interest to read the following extract from an article which appeared a few months ago in the English weekly paper "The Field", which has always been a staunch advocate of rural development :—

> "Modern veterinary practice approaches the incidence of disease from a new angle. Rather than prepare to cure the afflicted, it endeavours to build up a resistance within the animal to safeguard it against disease. It is the study of the animal in health as opposed to ill-health which yields the greatest information."

To attain this end, it is necessary to provide veterinary students of all classes with the means of obtaining daily contact with animals in health, as can be done by attaching a live-stock farm or a herd of dairy cattle to each veterinary college, and also to pay more attention in the curricula to the subjects of Genetics and Nutrition, and their application to animal health. If necessary, this must be done at the expense of such subjects as Anatomy and Surgery, for if the present-day "cow-shed clinician" is to be replaced by a more complete animal husbandman, the idea of training a man merely in the science and art of veterinary medicine and surgery, which is the acknowledged aim of most veterinary colleges to-day, will require revision and courses will have to be designed to provide a student with a sound knowledge of the three major subjects of medicine, animal nutrition and animal breeding, which are the basis of all live-stock improvement work. Moreover, a deeper study of animal Physiology and its allied subjects should tend to widen the outlook of the veterinary student and develop his imagination.

The importance of a general knowledge of a clinical subject like surgery must not be overlooked, but to obtain more than ordinary competence in this and other clinical subjects a student might be expected to take post-graduate instruction, as he would if he wished to specialize in any of the laboratory subjects, and it is, of course, most important to frame the curriculum in such a way that specialisation in any subject immediately after graduation is rendered easy.

In this connection attention may be drawn to the desirability of encouraging veterinary graduates to specialize in subjects other than Pathology and Bacteriology. A vast field awaits investigation on the veterinary side of such subjects as Protozoology, Helminthology, Entomology and Biochemistry, and also in Animal Physiology, Animal Nutrition and Animal Genetics, and while we must express gratitude for the help received in these subjects in the past from pure scientists and others, there can be no doubt that, given equal intellectual equipment, a veterinarian working in one of these branches of science should produce the more practical results.

This raises the question of what can be done to improve the flow of suitable recruits to the research side of the profession. In England this same question has recently been under consideration and as a result a course has been designed in which the student will spend his first three years at Cambridge University taking the Natural Science Tripos and the two final years at the Royal Veterinary College, London. In this way the two most important factors in the training of a veterinary scientist, *viz.*, the highest type of basic scientific education and a suitable animal environment, have been blended in an admirable manner.

ORIGINAL ARTICLES

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

X. THE UNITED PROVINCES CULTIVATOR

5. THE TURK CULTIVATOR OF ROHILKHAND

BY

MUNSHI TASAWWAR HUSAIN NAQVI, DIP. AGRI.

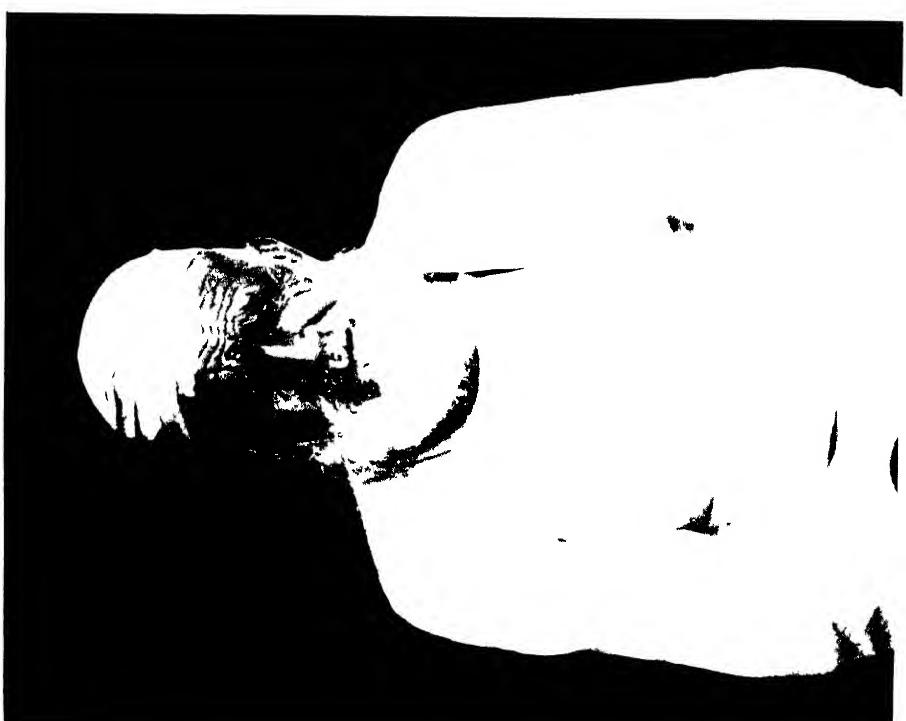
Divisional Superintendent of Agriculture, Rohilkhand and Kumaun Circle, Moradabad

ROHILKHAND is a part of the United Provinces of Agra and Oudh comprising the districts of Moradabad, Bijnor, Budaun, Pilibhit, Shahjahanpur, Bareilly and the state of Rampur. Literally speaking, Rohilkhand means the abode of the mountaineers. The name is derived from the Rohilla, a tribe of Afghan highlanders, who conquered this region towards the beginning of the eighteenth century. It covers an area of about 11,000 sq. miles and has a population of 5,481,577.

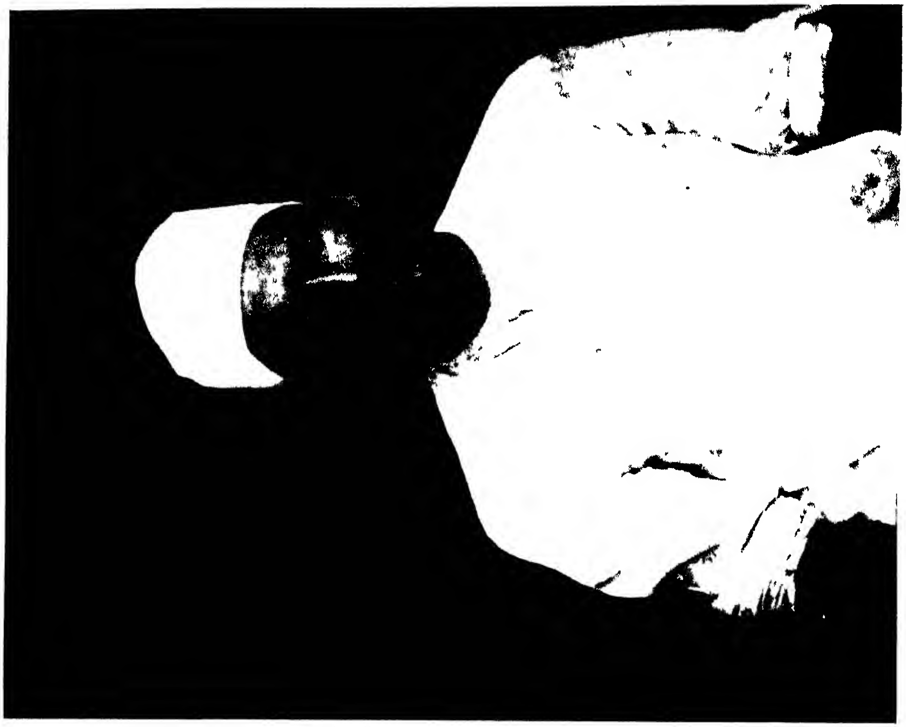
The Turk who represents a typical cultivator of this area is, however, a much older resident of Hindustan. His origin dates back from the invasion of Mohamed Ghori in the year 1192 A. D. Under the command of Salar Masud Gazi, one of Mohamed's generals, the Turks overran a greater part of the United Provinces till their progress was checked by the general's death in Behraich.

Though the Turk has settled down to a peaceful life of cultivation and hard toil, he has not forgotten the martial traditions of his race and the fierceness of his name and history are in no way belied. The intervening centuries have left no mark upon the soldier who came to India more than 700 years ago, but at the same time they have produced an exceptionally good type of farmer who plies his spade and plough with as much zeal and vigour as his ancestors wielded their swords. Efficiency, self-reliance, diligence and a religious outlook almost amounting to fanaticism are characteristic of these Turk cultivators. The Turk's hospitality is proverbial and no one can return from his door without partaking of

PLATE XXXI



An old Turk



A young Turk

A typical Turk enjoying his *hukka*

sharbat in summer and milk in winter. A *hukka* smoke is, of course, always offered. The Turk cultivator is also very kind to his animals.

As a cultivator, the Turk has acquired practical skill of a very high order which is embodied in his *reets* or proverbs. Put to the test of scientific knowledge, the *reets* are very instructive and accurate. It will not be out of place to quote a few of them here.

"*Cheede cheede till bhale aur cheedi bhali kupas*
Jeski cheedi eekh rahe uski nahin jineki aas".

i.e. "*Til* and cotton should be thinly sown but a man with a thin crop of cane should not hope to live."

"*Ghanna gehun boey ek bai aur eekh boey teh bai*
Larki ho tari khari Assar boey bari."

i.e. "If you have a virgin daughter to marry and want money, sow your wheat thickly behind the plough, your sugarcane with three ploughs and your cotton in *Assar* with the rains."

"*Dhan ghanna ban beghara, mendak phudki jowar.*
pehre pehre bajra to ghore ghoomen dewar".

i.e. "If you wish to be rich and have horses at your doors, sow your paddy thick, your cotton thin, your *jowar* at a frog's leap and your *bajra* a step apart."

There is a large number of such proverbs; in fact, for every agricultural operation some proverb or other comes handy to guide his conduct in the fields.

Suspicious of any outside interference, the Turk villages are closely knit together into a *bradry* (brotherhood) whose affairs are controlled by panchayats with annually elected *sardars* (presidents) at their heads. Usually a learned old man is chosen for the purpose. As the word signifies, the *sardar* is the greatest man in the *bradry*.

The panchayat controls all the activities of the community both internal and in relation with the outside world. Decisions on important matters are taken only after consulting the whole *brudry*, and once taken are binding on every member. Any flouting of this general will by an individual, any disregard of the established custom, or some moral turpitude, is seriously dealt with by the panchayat. The delinquent is severely ostracized which in their parlance is *hukka pani band karna*. This means that the man thus punished is not respectable enough to smoke the same *hukka* or drink from the same bowl as the honourable *bradry*. If the offender repents and expresses a desire to retrieve his guilt, he must atone for it by means of a grand feast to the whole community. The choice of the dishes rests with the latter. This is an excellent check on those who are mischievously inclined and tends to encourage good conduct and orderly behaviour. The panchayat

raises a small subscription from the members to meet those expenses that are collectively incurred by the whole *bradry*.

Marriage, the most important event of a man's life, is settled among the Turks as amongst most other communities in this country, by the parents of the couple. It consists of two parts—the *nikah*, a religious ceremony, and the *rukhsat*, the actual taking away of the bride. The *nikah* is often performed at an early age when the bride and bridegroom are ten or twelve years old. It is a strictly religious ceremony, two *maulvis* acting as agents, one for the boy and the other for the girl. After reciting verses from the Holy Quran, the contract is sealed and entries made in the *maulvis'* books. *Sharbat* and dried dates are then distributed to the company and for all theoretical purposes as also before the law they are husband and wife thenceforth. But the actual consummation takes place after the *rukhsat* which is usually done at a more mature age. *Rukhsat* is the time for celebrations and feasting. The bridegroom and his party visit the bride's place and are entertained by her parents to a feast of *bhat* (boiled rice) and *urdgosht* (meat and pulse curry). Having enjoyed themselves for two or three days at the bride's expense, the bridegroom and the party, which consists exclusively of men, return home with the bride. The couple departs in a *rath*, a decorated bullock charriot, while the others ride home in *rabbas* or light two-wheeled bullock carts. On reaching home, the bridegroom also celebrates the occasion by feasting the whole *bradry* if he can afford to do so, or at least by entertaining his friends and near relatives. The month of May is the marriage season, as by that time both the sugarcane and *rabi* crops have been harvested and there is some money to spend.

In a Turk family, duties are strictly apportioned between the males and the females. Men are responsible only for cultivation and other outdoor work, while the women folk manage the household, take care of the cattle, grind the corn, milk the animals, make ghee and sew and spin. Of the income, the portion derived from the sale of dung-cakes is the woman's exclusive share, which she usually spends in buying ornaments. A Turk wife is extremely obedient and faithful.

A Turk village is divided into *abadi* and the *har*. The *abadi* or populated portion is situated on a higher level from the *har* which is the surrounding cultivated area. Every village invariably possesses a mosque where men, devoutly inclined, offer their prayers. A *mulla* is usually in charge of the mosque and is maintained by the community. In addition to officiating at prayer time it is also a part of the *mulla's* duty to teach reading the Holy Quran to the village boys. The girls are generally not initiated into the art as reading and writing are not considered good for the fair sex.

The houses are usually of mud and thatch and consist of a living room, a kitchen, a *saar* or cattle shed and a courtyard, the whole being surrounded with a wall, as the women observe *purdah*. The well-to-do Turk also keeps a *choupal* outside

the purdah wall. *Choupals* are the meeting places of the men where they smoke and chat in the evenings. The size of the house and the presence of the *choupal* denote the prosperity of the family. All Turk houses are scrupulously clean, being plastered with mud and white-washed with *pindol* or whiteclay twice a year *i.e.*, before and after the rains.

The clothing requirements of a Turk are few. During working hours he puts on a *dhoti*, a *bundi* and a cap, while on festive occasions or when visiting another village he uses a *pajama*, a shirt, a *mundasa* or turban and a shoulder cloth (which is the equivalent of a gigantic handkerchief), and also indulges in the rare luxury of a pair of shoes. In winter a *chaddar* (thick *khadder* cloth) or a *mirzai* (a jacket stuffed with cotton) is worn during the day, while at night a *razai* (cotton-stuffed quilt) serves the purpose of both mattress and cover. The universal dress among the females is a *pajama*, a *kurti* or shirt, and a *dupatta* or head cover which also serves as a veil when they go out. Ornaments are of course indispensable and generally silver ones are used.

The daily food of a Turk consists of *roties* (unleavened bread), *dal*, *gur*, *matha* (skim milk) and *sag* or weeds picked up from the fields. Rice, meat and vegetable are occasional luxuries. Three meals are taken during the day, beginning with the breakfast at about 9 A.M. which is partaken of in the fields. The second or midday meal is taken at about 1 P.M. on returning home from work and the third at sunset. Guavas, melons and mangoes are the only fruits which he can afford.

Ghee-production and *khandsars* or indigenous sugar manufacture are the only two subsidiary paying industries. Although rearing of cattle, specially of buffaloes, is very common, it is considered below the dignity of a Turk to sell milk. He can only deal in ghee and must use the skim milk at home. A similar prejudice exists against hiring out bullocks or carts. *Khandsars* are owned only by the well-to-do Turks but this is a far-famed industry of Rohilkhand and there is no doubt that some of them are past masters in the art of *rab*-making. The industry has been famous for centuries and a story is told how the Great Akbar once tasted the sugar produced by the Turks and thenceforward always obtained his supplies of the article from them. Basket-making is also practised, but not on an extensive scale and is not very remunerative.

The only occasions when a Turk gets an opportunity for a little merry-making are the festivals of *Id* and *Charyan*. Both of them are, however, essentially religious in character. *Id* is the thanksgiving festival for the successful termination of *Ramzan*, the month of fasting among Musalmans. After the thanksgiving prayers, gaily dressed parties visit each other and are entertained to *siwanyan* (macaroni) and milk, while every one embraces every one else. *Charyan* is the name given to a *mela* held to commemorate the aniversary of Salar Masud Ghazi's invasion.

The occasion is celebrated in every village in which the Ghazi camped on his way to Bahraich. *Dungles* (wrestling) and fencing matches are held on this day and other feats of strength shown. The winners are garlanded, taken out in procession and feasted. Bullock racing is also a favourite amusement on this occasion and attracts large crowds. The religious side is, however, never forgotten. Alms are freely distributed and the poor fed by every one according to his means.

The economics of a Turk village is based on barter. At harvest, every Turk cultivator pays the village carpenter, the blacksmith, the sweeper and the barber a certain portion of his produce for their services during the past six months.

[*Agriculture and Live-stock in India*, **Vol. VIII, Part V**

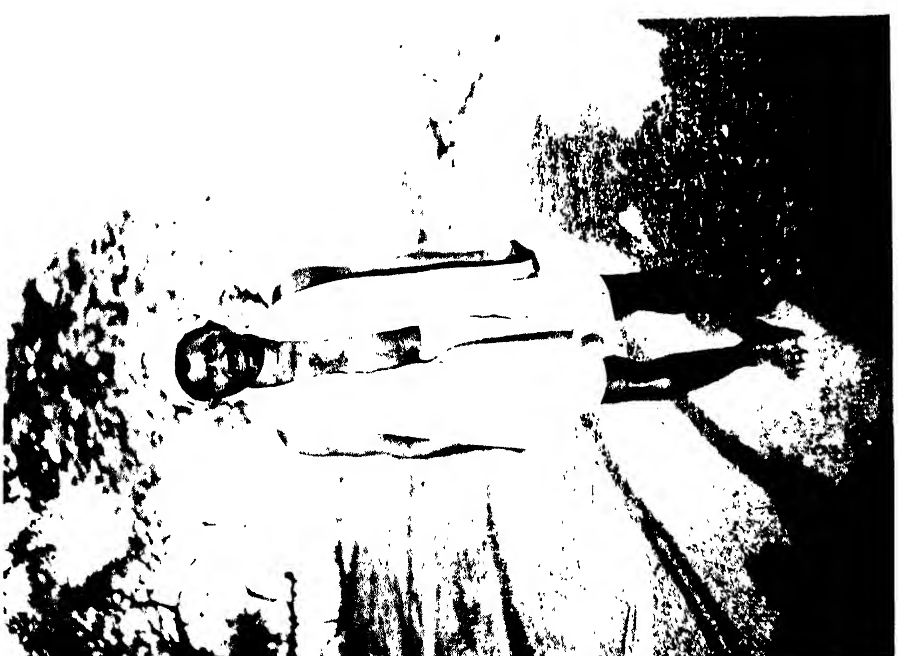


FIG. 1. A Teli Cultivator
(Central Provinces)

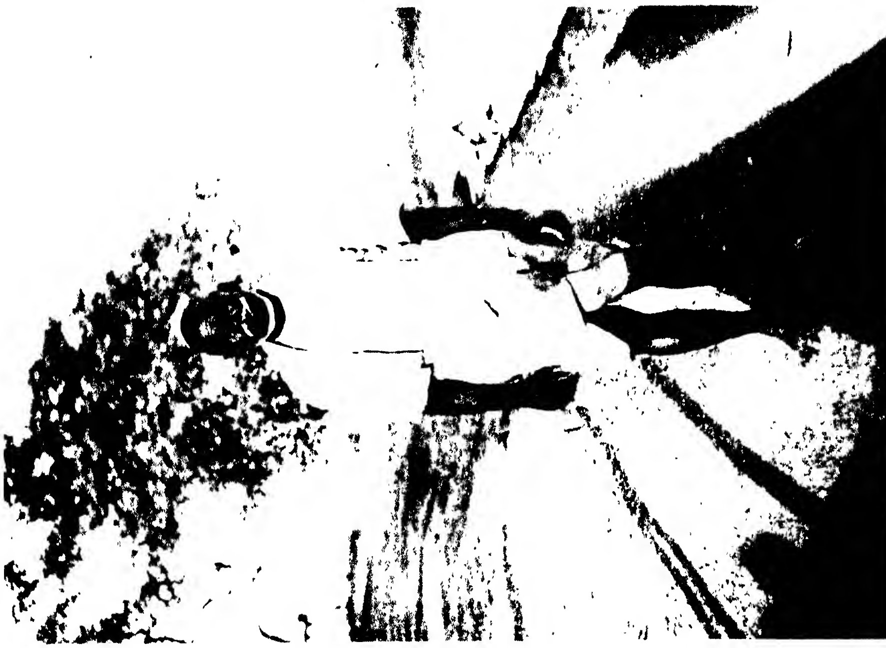


FIG. 2. A Satnami Cultivator
(Central Provinces)

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

XIII. THE CENTRAL PROVINCES CULTIVATOR

1. THE CHHATTISGARH CULTIVATOR

BY

RAO SAHIB D. R. MOHARIKAR

Deputy Director of Agriculture, Raipur, Central Provinces

SEVERAL types of soil are to be found in the typical Chhattisgarh village, ranging from *bhata* (red gravelly soil) at the highest levels to heavy black soil in the low-lying portions. Intermediate types lie between these two extremes. Though a variety of crops could be grown under these conditions, paddy is the most favoured crop and occupies the biggest area. In some tracts where heavy soils abound, both *rabi* and *kharif* crops are grown.

There are two main cultivating castes, the Telis and Satnamis. Both are simple and straightforward in character, but the latter is inclined to go to extremes when his feelings are roused by village factions. The chief articles of clothing are a *patka* (loin cloth) and a *paga* (small turban). A country woollen blanket, a bamboo hat, a pair of sandals and a big bamboo stick complete his turnout for all seasons. He is of medium stature, brown complexion and fairly good physique.

His main meal consists of cooked rice served with either a pulse or seasonal vegetables, whichever be available. It is eaten in the evening after a hard day's work. A little rice is left over from the evening meal for the next day. This is put to soak in water and the result is *basi* which forms his next meal, taken at midday after his bath. On festive occasions he is very happy if his ordinary fare is supplemented with fish and *bhajias* (sweetened wheat or rice flour paste, fried in oil or ghee in small lumps). He cannot, however, forget his *chongi* (pipe) of which he is very fond; he will have it at any cost.

In the *basti* there is much overcrowding of houses. Of roads in the proper sense there are none, only narrow tortuous lanes. The houses have mud walls and tiled roofs. It is customary to have small separate buildings to serve as kitchen, guest room, sleeping accommodation, and cattle shed. Windows have no place in their houses. The only articles of furniture are a few cots made of bamboo and rope. The utensils include brass dishes and *lotas* and mud pots for

cooking. Mud or bamboo bins are constructed in each house to store the produce of the fields.

Social customs.—Socially there is great unity between persons belonging to the same caste. Each caste has its own *panchas* who act as head of the caste and their decision is final in every caste quarrel. For breaking caste rules, persons are outcasted. If any person of the lower caste beats a person of the upper caste, the latter is outcasted. Inter-dining is also prohibited and outcasting is the punishment inflicted in this respect as well. The *panchas* assemble, frame charges against the accused who, if proved guilty, has to pay a fine before he can be re-admitted. This fine is generally utilized to provide a feast for the caste people who collect in great numbers on such occasions.

Betrothal is the first step in marriage negotiations ; at times this takes place when the child is still in the womb. Child marriage is the general rule, but the girl is never sent to the husband's house till she attains the age of puberty. It is incumbent on the parties to invite all caste people to the ceremony and as a general rule most of the people attend. Two or three dinners from the bride's side and one from the bridegroom's complete the ceremony. It is customary for the near relations to contribute something in kind to help the fathers of the bride and bridegroom.

The Chhattisgarhi cultivator puts in just enough work to maintain himself and his family in a very humble way. In tracts where paddy is the only crop, his field work starts with manuring the fields in May, followed by sowing operations which commence with the break of the monsoon and last for a month. July and August are months of hard labour in the field for *biasi* and weeding operations. Once the paddy is in ear and wild rice (*karga*) is eliminated, he gets some leisure. He finishes his harvesting and threshing by the end of December and has ample time at his disposal thereafter. The more needy supplement their earnings by undertaking carting work or other outside labour when there is nothing to do in the fields. In tracts where irrigation facilities are available, the cultivators are taking to planting sugarcane and thereby increase their income. Where *rabi* crops are grown as well as *kharif*, the cultivator is kept fully engaged. Scattered holdings are a great handicap in this tract but the benefits of the consolidation now in progress are fully realized. The Chhattisgarhi cultivator is an expert in laying out catch-water drains in right contours to take the water from higher areas to his fields.

The main causes that have contributed to his poor financial position are neglect of manure and cattle. He burns two-thirds of the dung produced and one-third is preserved for manure. It is only of late that he has taken to better preservation of manure. He believes in keeping a large number of cattle, beyond his means to feed properly, with the result that their condition is wretchedly poor and he sustains great loss from deaths. This takes him to the door of the money-lender and, once in the grip of the latter, he is very much handicapped and enterprise ceases,

The tiller of the soil is very fond of attending weekly bazars, where both sexes flock in great numbers. He will also observe the numerous festivals no matter how urgently field operations may claim his attention. He seems to forget his worries, for the time being and enjoys these outings thoroughly. After all he is proverbially a contented man. This contentment is, however, not natural but has been brought about by the conditions under which he has been living. Every attempt on his part to improve his lot having proved a failure, he has begun to believe that he was destined to lead the sort of life he is leading and this has tended to kill all initiative in him. For this he himself is mainly responsible, though he does not realize it. He permits a number of leakages in his income of which the most important are expenses beyond his means for marriages or after a death in the family, wrong notions of charity which enable swindlers to deprive him of a good share of his produce at the time of threshing, advance credit purchases of clothing and utensils before harvest time at enhanced prices from itinerant dealers, and absence of any organization to save him from the loss sustained in the purchase of his requirements or in the sale of his produce. His case can be likened to that of a man trying to replenish a water pot with a number of holes in the bottom. The more he pours in, the greater the flow from the holes because of the extra pressure. It is, therefore, as necessary to stop the leakages in his income as it is to increase his resources. It is very difficult to convince him of the merits of any improvement but once convinced, he takes it up in right earnest and follows it with zeal. There are encouraging signs that he has begun to realize the importance of good seed, improved tillage and adequate manuring and that he is awakening to the possibility of utilizing these improvements for his own benefit and not that of the money-lender. He is also beginning to see some meaning in the suggestions for co-operative action which are being patiently instilled into him by the various departments.

THE SYSTEMATIC IMPROVEMENT OF LIVE-STOCK IN INDIA

BY

COL. SIR ARTHUR OLVER, C.B., C.M.G., F.R.C.V.S., F.N. I.

Animal Husbandry Expert, Imperial Council of Agricultural Research

As I am shortly vacating my appointment of Animal Husbandry Expert, I feel that I ought to place on record, for the information of those who have not had the same opportunities, the conclusions which I have formed after eight years of close study of the problem of live-stock improvement in India.

SYSTEMATIC BREEDING CONTROL IN THE VILLAGES GENERALLY MOST EFFECTIVE

For improvement on the vast scale which is needed, it is obvious that few Governments can afford to undertake the actual breeding, on Government farms, of sufficient numbers of suitable sires. Nor can they afford to maintain the large numbers of special staff which would be required for systematic live-stock improvement throughout the country, in addition to the extensive provincial Veterinary Departments which, owing to the lack of veterinary practitioners in India, Provincial and State administrations are compelled to maintain for the control of disease.

SUITABLY TRAINED STAFF DEVOTED TO LIVE-STOCK ESSENTIAL

Experience has, moreover, shown that it is generally more effective and cheaper to help and encourage village breeders to improve their own stock, by systematic breeding and disease control in the villages, than to attempt to breed the very large numbers of sires required, but this can only be done where adequate and suitably trained staff exists, in close touch with the live-stock of the country. Such staff, suitably distributed at veterinary hospitals or other centres is therefore essential and as it is not possible to deal with the whole country at once, it follows that control should first be concentrated in the areas where the best recognized breeds are at present found and where the breeding of improved live-stock is economically feasible. Before deciding on a plan of campaign, it is thus necessary to make a rough survey to determine broadly the areas in which definite types at present exist and to choose suitable breeding centres, for each breed, at which suitably trained personnel is likely always to be available to carry on the systematic control, which is necessary for lasting progress.

Pedigree registration necessary

It is true that some improvement, particularly in the first generation, can be achieved by buying non-pedigree bulls and issuing them to villages where the cattle are poor, even where strict breeding control does not exist. But lasting progress cannot be expected unless arrangements are made to provide an adequate supply of sires whose genetic origin is known and to carry on systematic registration, not only of bulls and their progeny but also of selected cows whose approved progeny could in course of time be registered as pedigree stock. This seems to me the only way in which it will be possible to provide, throughout the country, for the gradual breeding up of a cadre of pedigree stock, which could eventually be drawn upon to provide the great numbers of pedigree animals which are needed for systematic live-stock improvement.

Best cattle in areas where free grazing is scanty

It will probably be found that the areas in which the best cattle are bred, and which should be developed first, are areas in which free grazing is scanty and where attention is paid to the production of fodder crops to supplement such free grazing as is available. Under fodder crops, I include cultivated or properly managed grazing, the most valuable of all fodder crops, and grain crop residues of good feeding value such as *kadbi.*

It has in fact been found in India, as in other countries, that if full advantage is taken of the manurial effect of their urine and dung, the gross return from the land and profit per acre can be greatly increased by well-fed live-stock under a balanced system of mixed farming. Moreover, properly managed live-stock, besides increasing the return from the land, has the effect of equalizing the income over a series of years, while in mixed farming a large proportion of the return is obtained from animal products, such as dairy products, without which it is not, as a rule, practicable to provide a satisfactory diet for the people, and at the same time comparatively high priced work-cattle can be bred. For these reasons, I have for years past advocated that mixed farming with reasonably high yielding cows should be adopted wherever possible as likely to be the only way of enabling agriculture in India to meet the ever-increasing pressure on the land.

Foreign breeds unnecessary

The improvement of live-stock, and of cattle in particular, is indeed a matter of great social as well as economic importance and urgency in India and it is necessary to emphasise that it has now been amply shown that it is unnecessary, and unsound as a general policy, to attempt to introduce European breeds of cattle into India. Systematic investigation, carried out by the Animal Husbandry Bureau of the Imperial Council of Agricultural Research, has shown that, by careful selection and proper feeding and management, herds of pure Indian dairy cattle have already

been produced within twenty-five years, which can more than hold their own in India, with European cattle and with the best Indian buffaloes, in economy of milk and butter-fat production [Kartha, 1934]. Already they exceed the average milk yield of commerical dairy herds in Europe and America and there is every evidence that these results are likely to be steadily improved upon for years to come, while it has clearly been demonstrated that, even with the best of care and under the best possible conditions, cattle of European origin always tend to degenerate in India.

Nor should it be forgotten that, if a policy of using imported cattle were adopted, it would be necessary to keep up, year after year, a huge supply of pedigree sires, purchased abroad at very high prices, the cost of which would generally be prohibitive. Without most careful and expert breeding control, the use of foreign cattle for stud purposes is moreover very dangerous. Indeed, it has already done incalculable harm by destroying valuable pure-bred herds of Indian cattle by unscientific mating.

Systematic breeding control in villages by an expert department devoted solely to live-stock

It is far sounder, therefore, to effect systematic improvement by means of selective breeding and better feeding and management of indigenous stock than to attempt to grade them up by the importation of stock of European origin. Systematic breeding control by a suitably trained Government Department, devoted solely to the interests of live-stock, thus appears to be the only sound policy and it is now clear that the most far-reaching results so far obtained in India have been secured under some system of providing approved sires ; purchased as far as possible from breeders in the best breeding areas and issued under subsidy or on concession terms under the supervision and control of such a Department.

Issues on part payment system

Probably the cheapest, most effective and lasting method of all appears to be to purchase suitable sires in the best breeding areas and to issue them under some system of part payment ; the animals becoming the property of their allottees as soon as their total cost has been repaid to Government, in annual instalments. Some such system has been extensively adopted in various parts of India and the following terms are suggested as likely to prove suitable :—

(*a*) When a village in a cattle-breeding tract requires a new bull, the local representative of the department responsible for cattle-breeding should arrange, in collaboration with the principal breeders of the area concerned, to purchase a suitable bull, either in the same area or from an area where a better class of animal of the same breed can be obtained.

(b) The bull should be issued to a selected custodian, on payment of 25 per cent of the cost price, and a register kept by the department of his services and progeny, the allottee being permitted to charge a reasonable service fee on the condition that the bull is always well-fed and exercised and preference given to registered females.

(c) At the end of the first year and each following year, the allottee should pay a further 25 per cent of the cost price, until the whole has been repaid to Government.

(d) The bull would then become the property of the allottee who would be at liberty to sell or otherwise dispose of it but not to retain it for service in the same area beyond the 4th year, by which time a fresh bull should be available, supplied by Government on the same terms, so as to obviate a bull covering his own daughters.

(e) Normally provided that he had proved a satisfactory custodian, a new bull would be issued to the same allottee as before, who would thus continue to pay to Government each year, 25 per cent of the cost of a new bull.

Economical method of employing Government funds

In this way, the bulk of the funds provided by Government for the supply of suitable bulls could be recovered and a great deal done for the systematic improvement of cattle at comparatively small cost. Should the bull die or prove unsatisfactory, the loss should, however, be borne by Government as a part of their contribution to departmentally controlled live-stock improvement.

Such a system has the advantages that it provides a remunerative market for well-developed young males from registered parents and, as the bull eventually becomes his own property, it would be in the custodian's interest to look after it properly.

It may be necessary to pay a small subsidy to ensure proper maintenance but experience has generally shown that there is not much difficulty in finding suitable custodians willing to take bulls on such terms and that wherever it is possible to purchase suitable bulls from breeders, under some such system, a great stimulus is given to better breeding and proper care and management of stock.

Cows must also be registered

To get the best out of such a system, it is necessary that a few of the very best cows in the areas served by approved bulls should also be registered and they and their approved progeny tattooed as selected stock. Where good cows do not exist, it may be necessary to buy a few and issue them on similar terms to selected ryots, on their undertaking to feed them properly and mate them regularly with approved bulls. Such cows should obviously be of the same breed as the approved bulls working in the district and should be good milkers. Registers of all such

stock should be maintained at veterinary hospitals or other suitable centres, and annual cattle shows should be held at suitable fairs at which prizes and *sanads* would be given and suitable young bulls selected, annually, for purchase by Government.

To ensure proper development of these and to carry on systematic breeding of the very best strains available, particularly of dairy breeds, it will generally be found advisable for each Government to maintain at least one central breeding and rearing farm, within easy distance of a city where some experimental breeding can be carried on and a dairy maintained at moderate cost, and where elementary provincial instruction could be given in dairying and animal husbandry.

In order to build up an adequate cadre of pedigree animals within a reasonable space of time, it might be advisable also, for the first few years, to select, at local shows, a small percentage of the best heifers by approved bulls, but not out of registered dams, and to mark them as selected females whose progeny would become eligible for registration as pedigree stock, if found suitable in following generations.

Any stock produced from these females, by a pedigree bull, would in any case be considerably enhanced in value but to ensure proper care and supervision of all registered females and their progeny, it would be necessary to refuse to register any young stock not up to standard ; in size as well as conformation and type.

Registration should in fact be withdrawn if pedigree females or their progeny are not maintained in good condition or if a cow has proved an unsatisfactory breeder.

Prices paid by Government for young bulls must be remunerative

It is essential that the prices paid by Government for sires should be sufficient to encourage local breeders to feed their breeding females and young stock well and, before issuing a bull to a village, Government should insist that all other bulls, in the areas to be served by approved bulls, are castrated or otherwise disposed of.

Systematic castration essential

In any policy of live-stock improvement, one of the most important items must be the vigorous prosecution of systematic castration to eliminate all scrub bulls before they are old enough to commence service. Unfortunately the very degenerate scrub bulls commonly seen are very active servers and unless this side of the problem is successfully dealt with, little permanent progress can be expected. This work could under veterinary supervision be carried out by suitably trained stockmen along with other animal husbandry work.

Animal husbandry department essential, devoted solely to live-stock

The above are the general lines but pedigree breeding is expert animal husbandry work which can be satisfactorily controlled only by suitably trained staff

devoted solely to live-stock. It cannot be done by men, however trained, whose interest in live-stock is only subsidiary. In every province or state there should therefore be an expert department capable of undertaking systematic breeding control along these lines ; particularly in the best breeding centres for each important breed.

In addition to exercising systematic control of breeding operations and carrying on systematic castration and inoculation against disease, the animal husbandry department should maintain registers of all pedigree stock and should be responsible for the periodical inspection of all animals which are the property of Government or under subsidy, and should also keep in touch with their progeny.

Properly trained stockmen needed

To carry out this class of work, on the very big scale which is needed, some cheaper staff than qualified veterinarians will probably be found necessary and, if adequate progress is to be made, it seems certain that, as recommended by the Animal Husbandry Wing of the Board of Agriculture, it will be necessary to supplement provincial or state veterinary departments by employing suitable stockmen who, after six months veterinary training, could assist veterinary assistant surgeons in carrying out systematic castration and inoculation against disease and in the tattooing, registration and inspection of pedigree stock.

While carrying out this work in the villages, stockmen would be brought in close contact with village live-stock, of all kinds, and should be of great assistance to provincial veterinary departments in obtaining early information of disease. For this reason and to ensure proper supervision of castration and inoculation, it is clear that all stockmen should be under veterinary control.

By these means the whole of the provincial veterinary staff could be made full use of for systematic live-stock improvement and it should certainly be cheaper to strengthen existing veterinary departments by providing specially trained men in special lines such as dairying, sheep and goats and poultry than to attempt to provide the very large numbers of special staff which would be required if veterinary staff were not employed for live-stock improvement. Such specially trained men are necessary to form properly constituted animal husbandry departments capable of dealing authoritatively with every branch of animal husbandry work and should in any case be provided.

Class of cattle to be bred

Obviously the decision as to the class and breed of cattle to be used for breeding purposes is a matter of the first importance. As a general rule, it can be taken that where reasonably well-developed and efficient cattle already exist, it is sound policy to endeavour to raise them to higher standards, by selective breeding combined with better feeding and management and effective disease control. For

such work the method of issuing bulls on part payment and registration suggested above should prove the most satisfactory.

Degeneracy usually due to faulty feeding

In areas where cattle are hopelessly degenerate and inefficient, it may be taken that the main cause is improper feeding due, as, for example, is commonly the case throughout the rice-breeding tracts, to feeding mainly on defective fodder or to some mineral or other deficiency in the food stuffs available in the locality. For example, it has recently been shown that there are large areas in India where mineral deficiencies are so marked a feature that the breeding of good cattle is impracticable without special feeding. Other observations have shown that vitamin deficiencies are liable to be of great importance to stock-breeders in areas where there is a long dry period, unless adequate provision is made for the growing of fodder or semi-fodder crops which can be fed green in sufficient quantity to maintain health throughout the year. On the other hand, my own observations, supported by data obtained from farms under Government control in different parts of India, show that, with proper feeding and management, well-developed, efficient cattle can be produced and maintained except in areas, such as certain parts where the whole country is badly waterlogged during a great part of the year or where cattle are so infested with biting flies, ticks and other parasites that it is difficult for them even to maintain life.

Best cattle bred in drier tracts

As a general rule, it can be taken that throughout India the best cattle are bred in the drier tracts where free grazing is scanty and the grass grown is not coarse and this fact may be taken as a sure indication that the coarse grass produced in forest areas, under heavy rainfall conditions, is not sufficiently nutritious to produce good stock. In wet areas it is unlikely therefore that much improvement can be effected by the mere introduction of stock accustomed to drier conditions and more highly nutritious food stuffs. The policy should therefore be to endeavour to improve the local breeds by careful selection and systematic animal husbandry work designed particularly to provide better fodder and to control parasites which, in such areas, are nearly always a serious cause of degeneracy and ill-health.

In the rice tracts the degeneration of cattle which occurs appears to be largely due to the fact that the people are not cattle-minded and take no steps to provide nutritious and health-giving fodder or semi-fodder crops such as the legumes and grasses or *juar kadbi* which are extensively grown by cattle-breeders in districts where the best stock are bred and reared. It seems, however, that crops of this kind could usually be produced in the rice tracts if suitable seed were thrown in on the last watering of the paddy fields.

Necessary to demonstrate the value of well-fed milch cattle

In areas where the cattle are hopelessly poor and inefficient, it may even be necessary to introduce better stock from other parts of India to demonstrate to the ryot that good cattle, and in particular milch cattle, are very profitable if properly fed and maintained on the holding in such a way as to ensure that as little as possible of the manurial value of their urine and droppings is wasted. With a view to making rice growers more cattle-minded, I have recommended to provinces and states within easy reach of Calcutta that they should take advantage of the opportunity of obtaining good Hariana cows there, at moderate prices, and hand them over to selected ryots, on part payment terms, on the condition that the allottees undertake to introduce a sufficient proportion of suitable legumes or grasses into their rotation to supplement the usual rice straw ration. Such a system should make economical milk production possible and should enable the stock to be maintained in better condition all the year round. I have also suggested that a sufficient quantity of silage should be made for each of these cows from young grass or a leguminous or other suitable crop, quantities of which could be grown during the monsoon in such areas and cut at an early stage of growth, to ensure that sufficient succulent fodder would be available during the dry season. Under departmental supervision such cows should prove a valuable source of additional income besides producing useful young bulls or bullocks and should be useful as an object lesson not only to the allottees but to their neighbours as to the value of superior stock if properly fed. For rice tracts within easy reach of Calcutta, I have therefore recommended small type compact Hariana bulls and they are doing well and proving highly popular. In similar areas, not within easy reach of Calcutta, I have in the past recommended Tharparkar cattle and I consider that they or, even better, good Rath cattle should prove the most suitable. Both are very compact and hardy and good milkers and Rath cattle in particular are quick, active workers.

Fodder-crops essential

It is a truism that no good stock can be bred without proper feeding and management and that the best blood in the world is useless unless it can be given the best opportunity to express itself in development. I have already mentioned that throughout India the best cattle are to be found in areas where free-grazing is scanty and where in consequence stock-owners are compelled to grow sufficient nutritious fodder-crops or semi-fodder crops to supplement such free grazing as may be available. Throughout vast tracts of India these facts are however either not known or ignored and attempts are made to provide for the want of really efficient cattle by maintaining large numbers of poor stock, on free grazing which are incapable of producing useful work bullocks and are of little value either as milk producers, or as soil fertilizers, since their droppings are mostly deposited on land not under cultivation. To emphasize this point it may be mentioned that

while a good pair of well-developed oxen may easily fetch from three to four hundred rupees it is possible to obtain large numbers of the poor type of bullock bred in forest areas, where coarse grass is produced in large quantities, at an average of Rs. 10 a head.

Milk and dairy products an important source of profit to cattle breeders

We have recently had well authenticated figures from a large number of cattle-breeders which show that though the breeding of work bullocks is regarded as their main business, the profit derived from the sale of moderate priced bullocks bred mainly on free grazing is small compared with what is derived from the milk or other dairy produce obtained from their mothers. The truth of this has been verified in other parts of India, where conditions are quite different, and if full benefit is to be derived from Indian agriculture, it is, I believe, essential that more should be made of the milk which, by proper feeding and management, under a proper system of mixed farming, could be derived from the mother of the working ox. As a side line of mixed farming milk can in fact be very cheaply produced and, provided that arrangements can be made to provide a steady market, might well prove the most profitable of all cottage industries and one which the women-folk of the family could usually undertake. Indeed to increase fertility and the return from crops every cultivator should devote a sufficient proportion of his land to the production of fodder or suitable leguminous crops, so that the whole area would come under such crops and be grazed by stock at least one year in every five or six.

Cultivation of leguminous and other fodder-crops should be encouraged

The cultivation of leguminous and other fodder-crops such as lucerne, berseem, *senji*, *guara*, Sudan and Guinea grass and crested wheat grass and semi-fodder crops such as *juar*, should therefore be encouraged and the great value of a reserve of ensilage for use in the dry season should be explained. Reasonable concessions to cultivators to grow such crops should be given and every effort should be made to popularize silos for conserving grass or green crops cut at an early stage of growth. Experience has in fact shown that valuable working cattle can be satisfactorily bred and maintained on the holding, by growing legumes and fodder-crops in the rotation, and that their owners, in addition to producing useful work bullocks can thereby obtain a most valuable addition to their income, from suitable cows.

More milk should be bred into Indian breeds of work cattle

Such a system, however, postulates the breeding of a reasonable amount of milk into the recognized working breeds and I am sure, from my own observations and from the observations of experienced breeders of Indian cattle that, up to milk yields considerably beyond what would be necessary, this can be done without damage to the stock as work animals.

Production of cheap milk

Probably the greatest boon which any philanthrophist could confer on India to-day would be to at least double the total output of milk. To do so is, however, no easy matter. Milk production on special dairy farms is only profitable where there is an easily accessible market for liquid milk, at prices much higher than the poor can pay, and it seems that reliance will have to be placed on the production of milk as a side line of mixed farming if cheap milk is to be made available in adequate amounts throughout the country. The production of milk, at the same time as useful bullocks, as a cottage industry, supplementary but subsidiary to the main activities of the cultivator, in fact appears to be the only solution.

Government and wealthy philanthrophists ought therefore to do every thing possible to encourage this by investigating the problems involved in the handling, processing and transportation of milk under Indian conditions and in the manufacture of ghee, *khoa*, etc , and by establishing collecting centres at suitable points, all over the country, at which a steady market would be made available, all the year round, for milk, cream, ghee and other cottage produce such as eggs and honey. They should also assist poor cultivators to secure good cows as well as reliable seed from which to produce the succulent fodder-crops which are necessary to make even the best cows really profitable.

The prices given at such centres need not be high. Indeed it would be a mistake to make them so because the main purpose should be to bring milk and dairy produce in India to price levels at which poor people would be able to buy them in reasonable quantities. At present milk, even at the rates at which it is obtainable in rural areas, is much more costly than in countries where dairying is a well-organized rural industry and, for years past, I have emphasized that until steady markets are provided in rural areas, at which small producers can be assured of a steady outlet for their produce, very little can be done.

On the other hand there is ample experience to show that wherever such centres have been established, in various parts of India, the supply of milk has rapidly increased and the villagers have become more prosperous.

The usual system is to obtain cows through the milk-buyer and to pay for them in milk so that the cows eventually become the sole property of the milk producer.

Calves should be weaned

In this connection. it is of the greatest importance that village producers should be taught that it is easily practicable and profitable to wean the calves of Indian cows at birth and rear them by hand, in the same way as has become the universal practice in all progressive dairy countries. Until it is, little general progress can be hoped for in improving the average yields of Indian breeds of dairy cattle but the general adoption of this practice would have a very beneficial and far reaching effect on the development of dairying in India.

Harm done by lack of green fodder during winter

The need for fresh green fodder to keep animals in health is well recognized all the world over but in many parts of India there is difficulty in obtaining any fresh growth for several months each year and during the past few years we have obtained definite evidence that a great deal of harm is done to breeding stock owing to the lack of essential vitamins which this lack of fresh green food entails. For example, on a certain farm where the lack of fresh green food was extreme, as many as 40 per cent of otherwise well-fed and managed cows, which did not receive any green food for several months each year, produced blind or otherwise badly developed calves which usually did not survive and if they survived were of no value. A careful study of their feeding and investigations, carried out at the Mukteswar Research Institute, has shown that this condition was due entirely to lack of green food and since an adequate supply of locally grown green fodder has been made available the cows have produced normal calves, thus making it possible again to carry on breeding satisfactorily in this herd. This was an extreme case but it is clear that a great deal of harm is done, each year, to cows which have an inadequate supply of freshly grown green fodder and that every effort should be made to provide a sufficient supply of such fodder, or silage prepared from young grass or other immature fodder crop, all the year round.

Other classes of stock dealt with on similar lines

Sheep, goats, poultry and horse breeding could be dealt with from veterinary hospitals or other suitable centres along similar general lines ; by providing suitable sires or breeding units on an instalment system of payment. In this way pedigree breeding could be carried on under the supervision of the department concerned, and this department, besides obtaining suitable breeding stock and arranging for the necessary exchanges of males, should be responsible for giving advice as to the proper care and treatment of stock, in health as well as in disease.

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THE QUALITY OF SUGARCANE IN NORTHERN INDIA IN RELATION TO BORER INFESTATION AND DISEASE INFECTION

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IN the September 1937 issue of *Agriculture and Live-stock in India*, there appeared an article by one of the subscribers, giving in detail the results of a borer survey made over the supplies of cane delivered during February 1937 to ten factories situated in Northern India and whose operations are controlled by Messrs. Begg Sutherland & Co., Ltd., Cawnpore.

With a view to ascertaining whether there had been a decrease or increase in the degree of infestation a survey was again carried out in February 1938 but on a more extensive scale

The areas from which the factories drew their supplies were divided into circles so that a comparison of the quality of the cane in respect of each circle could be determined from the results of the survey. The examination of the cane was made at the factories and every precaution was taken to make the survey representative of (*a*) the circle whence supplies of cane were drawn and (*b*) the material delivered to the factory The procedure adopted was to draw at random from the cane carts or railway wagons, the source from which the cane was supplied being known, one hundred stalks of cane. The stalks were then split longitudinally and after a count of the number of sound and infested stalks, weighment of the sound and infested cane was made. A stalk although only showing the slightest degree of infestation was classed as infested and the latter included canes which, while not showing evidence of actual wound injury from borer, presented symptoms of disease as shown by the presence of discoloured pith. Finally, the sound and infested canes were subjected to analysis which included the determination of solids, sugar and purity of the juice expressed by a hand mill. From these analyses, passage to the composition of the cane and to the yield of sugar in the factory was made according to the scheme given in detail on pp. 600-601 of the September 1937 issue of *Agriculture and Live-stock in India*.

At each factory, several circles were examined daily and at the end of the survey, the results were tabulated and averaged for each respective circle. According to the percentage proportion of supplies from each circle, the yield of sugar was then determined to obtain a direct comparison with the actual results recorded by the factory for the month of February, and so afford some indication of the loss of available sugar due to borer and disease. In Schedules I to X are given the detailed results of the borer survey in respect of each factory while Schedules XI and XII give the principal comparative results as revealed by the borer survey carried out in February 1937 and 1938 for the factories situated in North Bihar and Eastern United Provinces.

Factories situated in North Bihar

Factory No. 1.—The borer survey in February 1937 indicated an infestation of 48·68 per cent while from the February 1938 survey the infestation is recorded at 42·68 per cent. The surveys carried out in 1937 and 1938 indicate that the degree of infestation is fairly uniform for all circles examined. During the past season, a stricter supervision has been maintained over the supplies delivered to the factory and a decrease of 6 per cent in the degree of infestation can be partly attributed to the fact that rejections of infested cane were often made. Although the results indicate that there has been an improvement in the quality of the cane as delivered to this factory, following a decrease in the degree of borer infestation, it will be noted from Schedule I that the loss of available sugar for the month of February 1938 is estimated at 6,116 maunds, equivalent to a depression of 1·07 per cent yield of sugar on cane crushed.

Factory No. 2.—Schedule II gives the detailed results of the borer survey carried out at this unit during February 1938, and, it will be noted that the average per cent degree of infestation is recorded at 32·33 per cent as compared with 34·6 per cent reported for February 1937. Apart from circles No. 4 and 7, which record infestation degrees of 49·0 and 43·2 per cent respectively, the other areas appear to be infested to approximately the same degree.

According to the results of analyses, the average yield from mixed supplies is estimated at 10·02 per cent which compares most favourably with an actual yield of 10·01 per cent recorded by the factory for the month of February 1938, whereas, if all supplies had been sound, the estimated average yield would have been 10·81 per cent. As this unit crushed 5,84,710 maunds of cane, during the month under review, the loss of sugar due to borer and disease may be estimated at $5{,}84{,}710 \times (10{\cdot}81 - 10{\cdot}02)/100 = 4{,}619$ maunds.

The estimated yield from mixed supplies in February 1937 was recorded at 9·76 per cent, whereas, for February 1938 the yield of sugar from mixed supplies is given as 10·02 per cent. This increase in the sugar recovery can be partly attributed to a reduction of 2·27 per cent in the degree of infestation but chiefly to a general improvement in the quality of disease and borer free cane.

Factory No. 3.—Twenty-eight circles were examined at this unit and during the survey 11,500 stalks were examined, 4,201 of which were found to be infested, representing a 36·53 per cent degree of infestation or an increase of 1·73 per cent over that determined in February 1937. The lowest degree of infestation is recorded at 14·00 per cent for circle No. 13 while the maximum is given as 55·5 per cent for circle No 24 which indicates the variation in borer infestation as from circle to circle whence this unit draws its cane supplies.

According to the proportion per cent total supplies from each circle, the yield of sugar from sound cane during the month of February 1938 would have been 10·66 per cent as compared with 7·61 per cent from infested cane, while the average yield from mixed supplies is given as 9·52 per cent which compares very favourably with an actual sugar yield of 9·49 per cent recorded by the factory. Since this unit crushed 5,15,188 maunds of cane during the month of February 1938, the loss of commercial sugar due to borer attack and disease may be estimated at 5,15,188 × (10·66—9·52)/100=5,873 maunds, equivalent to a depression in the sugar yield of 1·14 per cent on cane.

Factory No. 4.—Only four circles were surveyed and from an examination of 7,800 stalks of cane, 3,357 were found to be infested indicating an infestation degree of 43·04 per cent or a decrease of approximately 13 per cent from that recorded for February 1937. This marked decrease in the degree of infestation is reflected in the results recorded by this unit in February 1938, since an actual yield of 10·62 per cent was obtained as compared with 8·64 per cent for February 1937. Nevertheless, it will be observed from Schedule IV that the yield from sound cane would have been 12·31 per cent as compared with 8·17 per cent for infested cane, and, 10·54 per cent for mixed supplies which compares very favourably with an actual yield of 10·62 per cent as recorded by the factory for the month of February 1938. Although there has been a marked improvement in the quality of supplies delivered to this factory, an infestation degree of 43·04 per cent has been responsible for a loss of 9,125 maunds of commercial sugar.

Factory No. 5.—Schedule V indicates that five circles were surveyed and from an examination of 9,500 stalks of cane, 4,034 stalks were found to be infested, indicating a 42·46 per cent infestation degree or an increase of 2·46 per cent over and above that recorded for February 1937. Also it may be noted that the degree of infestation is very uniform for all circles.

According to the analyses of sound and infested cane, the average sugar yield from mixed supplies is estimated at 10·87 per cent as compared with an actual factory yield of 10·78 per cent, but, if all supplies had been sound, the estimated yield would have been 12·18 per cent representing a loss of 7,795 maunds of commercial sugar due to borer and disease. For February 1937, the estimated yield from mixed supplies was given as 10·15 per cent as compared with 10·87

per cent for February 1938, but, a reference to Schedule XI will indicate that the improved sugar yield can be attributed to an increase in the sugar content not only of sound cane but also of infested cane.

Factories situated in Eastern United Provinces

Factory No. 6.—Nine circles were surveyed at this unit and Schedule VI indicates that 5,846 stalks were infested from a total of 18,200 stalks examined, representing an infestation degree of 32·12 per cent as compared with 31·11 per cent reported for February 1937.

The analyses results indicate that this unit would have recorded a sugar yield of 11·20 per cent from sound cane as compared with 8·45 per cent from infested cane, while the estimated yield from mixed supplies on a weighted average basis is given as 10·43 per cent which compares quite favourably with an actual factory yield of 10·32 per cent for the month of February 1938. As this factory crushed 5,03,377 maunds of cane during the month under review, the estimated loss of sugar is given in Schedule VI as 3,876 maunds.

Factory No. 7.—Schedule VII gives the detailed results of borer survey for eleven circles supplying cane to this factory and from a total of 12,871 stalks of cane examined, 5,514 stalks were found to be infested, representing an infestation degree of 42·84 per cent or a decrease of 2·82 per cent in the infestation degree from that recorded in February 1937. The minimum infestation degree is 34·98 per cent for circle No 4 and the maximum 62·8 per cent for circle No. 7.

According to the analyses results of sound and infested cane, the average sugar yield from mixed supplies is estimated at 10·93 per cent as compared with an actual factory yield of 10·67 per cent, but, if all supplies had been sound, the estimated yield would have been 11·98 per cent, representing a loss in February 1938 of 5,841 maunds of commercial sugar due to borer and disease attack.

From Schedule XII, which gives the comparative analyses factors obtained from the surveys carried out in February 1937 and 1938, it may be noted that the quality of the sound and infested cane examined in February 1938 was much superior to that examined in 1937 even although an infestation degree of 42·84 per cent has been recorded.

Factory No. 8.—Eight areas were surveyed at this unit and from Schedule VIII it may be noted that 1,464 stalks were found to be infested from a total of 7,900 stalks examined, indicating an infestation degree of 18·53 per cent as compared with 17·33 per cent as reported for February 1937.

The analyses results indicate that this unit would have recorded a sugar yield of 11·58 per cent if all supplies had been sound, whereas, the estimated

yield from mixed supplies is given as 11·31 per cent which compares very favourably with an actual factory yield of 11·26 per cent. Based on the cane crushed for the month of February 1938, and the analyses factors determined from the survey, the loss of sugar due to borer and disease is estimated at 1,271 maunds.

Although an infestation degree of 18·53 per cent has been recorded, an examination of the data for sound and infested cane, as detailed in Schedule XII, would appear to indicate that the borer and disease attack has not been so virulent in the circles from which this unit draws its supplies as compared, say, with the circles from which Factory No. 6 draws its supplies.

Factory No. 9.—Twelve areas were surveyed at this unit; 5,750 stalks of cane were examined and 1,137 stalks were found to be infested, representing an infestation degree of 19·77 per cent or a decrease of 4·51 per cent in the infestation degree from that recorded for February 1937. From Schedule IX it will be noted that there are considerable variations in the infestation degree in respect of each circle examined, circle No. 4 having an infestation of 13·25 per cent as compared with 46·67 per cent for circle No. 11.

The analyses results from this survey indicate that the sugar yield from sound cane would have been 11·07 per cent as compared with 9·05 per cent from infested supplies, while the average yield from mixed supplies is recorded at 10·65 per cent, which compares most favourably with an actual factory sugar yield of 10·66 per cent for the month of February 1938. According to the cane crushed and the difference between the sugar yield from sound and mixed supplies, it may be estimated that this factory lost 1,968 maunds of sugar due to borer and disease attack.

Factory No. 10.—Schedule X indicates that sixteen areas were surveyed at this unit and from a total of 10,409 stalks of cane examined, 3,173 stalks were found to be infested, representing an infestation degree of 30·48 per cent or an increase of 4·21 per cent over the percentage recorded for February 1937.

According to the proportion per cent total supplies from each circle, and the results of analyses of sound and infested cane, the estimated sugar yield from sound cane is recorded at 11·66 per cent as compared with 9·29 per cent for infested cane, while the average yield from mixed supplies is quoted at 10·90 per cent which compares quite favourably with an actual yield of 10·71 per cent reported by the factory for the month of February 1938. According to the the sugar yields from sound and mixed supplies, it may be estimated that on a crush of 4,91,191 maunds of cane for the month of February 1938, this unit lost 3,733 maunds of commercial sugar due to borer and disease attack of the cane.

In Schedules XI and XII are collected the principal data relating to the results of the borer surveys carried out in February 1937 and 1938 at five factories situated in North Bihar and five factories situated in Eastern United

Provinces respectively. From these schedules, it will be noted tha for the group of five factories in North Bihar, 52,290 stalks of cane were examined in February 1938 as compared with 23,850 stalks examined in February 1937, while the degree of infestation is given as 38·75 per cent or a decrease of 2·57 per cent from the percentage recorded for February 1937. As the borer survey results carried out in February 1937 revealed the severe losses of available sugar which a factory would suffer if infested cane was milled, a stricter supervision over the supplies during season 1937-38 was maintained at all units, and, as many rejections of supplies were made, this factor may have contributed to a certain extent in a decrease of 2·57 per cent in the infestation degree from that determined in February 1937. Although it is gratifying to record a decrease, even although it may be small, an average infestation of 38·75 per cent for the supplies at the cane carrier is most serious since the estimated loss of commercial sugar due to borer and disease infestation, for the five factories in North Bihar for February 1938, amounts to 33,528 maunds.

Although a stricter supervision was also maintained over the supplies to the five factories situated in the Eastern United Provinces, it will be noted that from a total of 55,094 stalks of cane examined, 17,134 stalks were found to be infested, representing an infestation degree of 31·10 per cent or an increase of 2·03 per cent over that determined in February 1937. It will be of interest to note from the average analyses of the sound cane for factories in North Bihar and Eastern United Provinces that the sugar content of the cane is given as 13·45 and 13·57 per cent respectively, while the estimated extraction from mixed supplies is quoted at 10·27 and 10·84 per cent respectively which compares very favourably with the actual group sugar yields of 10·24 and 10·72 per cent respectively. The lower yield of sugar by the group of factories in North Bihar can be solely attributed, since the sugar content of the sound cane is very similar, to the fact that supplies of cane to the factories in North Bihar were infested to the extent of 38·75 per cent as compared with 31·10 per cent for supplies to the factories in the Eastern United Provinces. It may also be of interest to note that the average purity of the juice extracted from the infested cane is quoted at 79·99 and 82·31 per cent for the factories situated in North Bihar and in the Eastern United Provinces respectively, while the average sugar content for the Bihar group is given as 10·50 per cent as compared with 11·23 per cent for the Eastern United Provinces group which would appear to indicate that the borer and disease attack of the cane crop in North Bihar has been more virulent than in the Eastern United Provinces. Nevertheless, a loss of 16,689 maunds of commercial sugar for the Eastern United Provinces group is of such a serious nature that every available means should be adopted to reduce or eradicate the borer pest.

From the results of analyses, etc., obtained from the surveys carried out in February 1938, the writers feel justified in making the following further state-

ments. (These are in addition to those already made in the survey of February 1937) :—

1. From observations made over a period of years, the cane crop in North Bihar and Eastern United Provinces rapidly matures from the beginning of December until the beginning of April, the sugar content of the cane increasing from approximately 10 per cent to 13·5 per cent. However, where the cane crop was heavily infested, it has been noted that the cane gradually matures until approximately 12 per cent sugar is recorded in mid-January, but, after this period there is little or no increase and in mid-March the cane rapidly deteriorates. With a view to ascertaining whether there was a progressive loss of sugar throughout a season, when the cane had been attacked by borer or disease, an extensive survey was carried out at one unit and it was definitely established that there was a progressive loss since in January, February and March, the estimated loss in yield of sugar was calculated to be 0·56, 0·79 and 0·91 per cent on cane respectively.

2. Numerous tests have proved that the juice extracted from the sound part of a stalk of cane which has been attacked by borer is approximately four to six units lower in purity than the juice from an entirely sound stalk of cane.

3. From Schedules XI and XII it may be noted that there has been a considerable decrease in the weight per 2,000 stalks of sound cane reported in 1938 as compared with that for 1937, the average percentage decrease amounting to approximately 13·5 per cent for the Bihar group and 9·5 per cent for the Eastern United Provinces group.

   Attention may also be particularly directed to the relative low weight per 2,000 stalks of cane recorded by Factory No. 2 as compared with the weight reported, say, by Factory No. 5 also situated in North Bihar.

4. Although a much stricter supervision has been maintained over the supplies of cane to the group of ten factories, and many rejections have been made on account of borer infestation and disease, attention is drawn to an average infestation of 38·75 and 31·10 per cent for the group of factories situated in Bihar and Eastern United Provinces respectively. Due to the many rejections which have been made and the cane which the cultivator does not tender to

the factory on account of its poor condition due to insect pest attack, these degrees of infestation cannot be taken as truly representative of the cane crop in Northern India.

5. The financial loss to the miller can be fairly accurately estimated, since the results from the borer survey indicate that the group of ten factories during the month of February 1938, suffered a loss of 50,217 maunds of sugar or a financial loss of some Rs. 3,75,000 quoting sugar at Rs. 7-8 per maund.

6. Apart from the loss to the grower and miller. the question has a national aspect in so far as the Excise and Imperial Revenues suffer from the depleted yield. In item 5, the estimated loss to the group of ten factories during the month of February 1938 was given as 50,217 maunds of sugar and with the Sugar Excise Duty at Rs. 1-8 per maund, the revenue loss to Government would approximate Rs. 75,000. On the assumption that the loss in February is representative of the average monthly seasonal loss, the loss in revenue to Government over a season of five months would amount to some Rs. 3,75,000. Since there are some 65 factories operating in North Bihar and Eastern United Provinces and assuming that the quality of the cane milled by the group of ten factories is representative of the supplies to all factories, the revenue loss on Sugar Excise to Government may be estimated to approximate Rs. 24,00,000 during the year under review.

SCHEDULE I

Factory No. I

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yiely infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1	822	291	19·62	85·81	13·30	11 40	578	205	17·96	80 99	11 06	9·11	17·39	1 82	1·98	1·58	41·29
Circle 2	701	240	19·54	85·82	13·25	11·36	489	177	17 97	80·80	11 04	9 09	9·72	1·01	1·10	0·88	40·78
Circle 3	712	244	18·90	85·40	12·76	10·90	488	180	17·14	79 28	10 33	8·37	5·34	0·52	0·58	0·45	40·67
Circle 4	738	209	19·73	86·54	13·50	11·63	462	182	17 96	80 45	10 81	8·97	19 86	2·09	2·31	1·78	38·50
Circle 5	814	290	19·30	85·49	13·03	11·14	586	213	17 46	79·81	10·59	8·61	11·83	1·19	1·32	1·02	41·86
Circle 6	800	269	19·74	86·48	13·49	11·59	600	214	17·86	80·82	10·98	9·03	27·76	2·90	3·22	2·51	42·86
Circle 7	669	232	19·39	85·72	13 13	11·21	531	180	17·68	80·33	10·84	8·81	3·74	0·38	0·42	0·33	44·25
Circle 8	700	259	19·41	85·61	13·13	11·27	700	247	17·52	80·28	10 73	8·75	4 36	0·44	0·49	0·38	50·00
Totals and Averages.	5956	2014	19·45	85 85	13·20	11 31	4434	1598	17·69	80 35	10·80	8·84	100·00	10·35	11·42	8·93	42·68

Factory Results :—

Cane crushed during February . . . . 5,71,581 maunds
Sugar made during February . . . . 58,569 maunds
Yield of sugar per cent cane . . . . 10·25 per cent

Borer Survey :—

Yield of sugar from mixed cane . . . . 10·35 per cent
Yield of sugar from sound cane . . . . 11·42 per cent
Yield of sugar from infested cane . . . 8·93 per cent

Loss of sugar due to borer infestation and disease 5,71 581 × (11·42—10·35)/100 = 6,116 maunds.

SCHEDULE II

Factory No. 2

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	yield					
Circle 1 .	840	235	19·93	83·26	12·78	10·59	360	98	17·57	77 66	10·07	7·88	14 08	1·37	1·49	1·11	30·00
Circle 2 .	823	230	20·13	84·03	13·03	10 89	377	103	17·98	80·00	10·62	8·53	11·13	1·13	1·21	0·95	31·42
Circle 3 .	773	209	20·13	84·34	13 07	10·95	427	113	17·69	79·12	10·34	8·22	6·38	0·64	0·70	0·52	35·58
Circle 4 .	510	146	20·29	84·72	13·15	11·03	490	138	17·30	79·39	10·17	8·11	0·52	0·05	0·06	0·04	49·00
Circle 5 .	876	234	20·21	84·22	13·11	10·98	324	84	17·91	78·30	10·41	8·17	5·88	0·60	0·65	0·48	27·00
Circle 6 .	844	230	20·43	85·04	13·38	11·28	356	99	18 19	80·03	10·80	8·67	7·09	0·74	0·80	0·61	29·67
Circle 7 .	568	163	20·37	85·21	13 40	11·31	432	124	17·55	79·18	10·28	8·19	4·01	0·40	0·45	0·34	43·20
Circle 8 .	788	217	19·60	84·17	12·70	10 63	312	87	17·47	79 94	10·30	8·17	19·70	1 96	2·09	1·61	28·36
Circle 9 .	794	211	20·12	83 73	12·91	10·76	306	80	17·09	77·64	8·92	7·63	9·84	0·98	1·05	0·75	27·82
Circle 10 .	719	197	20·11	84·82	13·13	11·04	281	75	17·87	79 85	10·54	8·44	3·55	0·37	0·39	0·30	28·10
Circle 11 .	566	161	19·77	83·75	12·75	10·59	234	67	17·63	80·12	10 43	8·40	11·86	1 18	1·26	1·00	29·25
Circle 12 .	764	201	20·22	84·06	13·13	10·98	336	89	17·89	80·01	10·66	8·56	5·96	0·60	0 65	0·51	30·55
Totals and averages.	8865	2434	20·11	84·25	13·04	10·91	4235	1157	17·67	79·26	10·30	8·24	100·00	10·02	10·81	8·22	32·33

***Factory Results*:—**

Cane crushed during February . .	5,84,710 maunds
Sugar made during February . .	58,511 maunds
Yield of sugar per cent cane . .	10·01 per cent

***Borer Survey*.—**

Yield of sugar from mixed cane .	10·02 per cent
Yield of sugar from sound cane	10·81 per cent
Yield of sugar from infested cane . .	8·22 per cent

Loss of sugar due to borer infestation and disease 5,84,710 × (10·81—10·02)/100 = 4,619 maunds

SCHEDULE III

Factory No. 3

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1 .	848	287	19·53	86·32	12·75	10·67	452	155	17·06	79·41	9·75	7·58	17·0	1·62	1·81	1·29	34·77
Circle 2 .	1270	444	19·67	86·25	12·84	10·71	630	225	17·24	79·42	9·88	7·67	20·5	1·99	2·20	1·57	33·16
Circle 3 .	313	92	19·50	85·93	12·67	10·56	187	57	17·07	79·83	9·80	7·62	8·8	0·36	0·40	0·29	37·40
Circle 4 .	127	43	19·83	86·40	12·95	10·82	73	25	16·92	79·31	9·65	7·50	0·5	0·04	0·05	0·04	36·50
Circle 5 .	120	39	20·05	86·61	13·15	11·00	80	25	17·61	80·12	10·18	7·97	1·5	0·15	0·17	0·12	40·00
Circle 6 .	422	159	19·76	86·38	12·92	10·80	278	112	17·01	79·66	9·75	7·58	8·4	0·79	0·91	0·64	39·71
Circle 7 .	396	117	19·36	86·39	12·63	10·57	204	67	17·06	80·26	9·82	7·69	6·2	0·59	0·66	0·48	34·00
Circle 8 .	370	119	19·30	86·45	12·62	10·57	220	74	16·94	79·87	9·76	7·60	3·5	0·33	0·37	0·27	37·29
Circle 9 .	77	23	19·67	85·30	12·60	10·36	33	10	17·76	79·50	10·18	7·86	0·3	0·03	0·03	0·02	33·00
Circle 10 .	158	56	18·71	85·75	12·11	10·01	42	12	16·68	78·55	9·40	7·23	0·3	0·03	0·03	0·02	21·00
Circle 11 .	293	99	19·52	86·57	12·78	10·74	207	64	16·89	78·53	9·53	7·36	4·5	0·42	0·48	0·33	41·40
Circle 12 .	61	18	19·44	86·78	12·71	10·62	39	13	17·19	80·27	9·95	7·72	1·0	0·09	0·11	0·08	39·00
Circle 13 .	86	15	18·97	85·03	12·16	9·93	14	3	16·07	78·03	8·96	6·74	0·4	0·04	0·04	0·03	14·00
Circle 14 .	607	207	19·87	86·53	13·04	10·92	493	167	17·38	80·11	10·05	7·90	7·5	0·72	0·82	0·59	44·82
Circle 15 .	114	31	19·10	80·50	12·35	10·23	86	33	16·37	80·66	9·51	7·46	0·4	0·04	0·04	0·03	43·00
Circle 16 .	120	38	19·25	86·92	12·66	10·66	80	24	17·03	80·00	9·81	7·54	1·0	0·09	0·11	0·08	40·00
Circle 17 .	330	81	19·49	85·86	12·67	10·50	170	45	16·83	79·03	9·58	7·40	4·2	0·39	0·44	0·31	34·00
Circle 18 .	394	123	19·53	86·14	12·72	10·57	206	73	16·85	79·57	9·64	7·48	4·2	0·40	0·44	0·31	34·33
Circle 19 .	66	13	19·43	85·94	12·64	10·50	34	7	17·33	80·49	10·03	7·86	2·0	0·19	0·21	0·16	34·00
Circle 20 .	147	58	19·46	85·94	12·64	10·40	53	24	17·06	79·71	9·80	7·63	1·0	0·10	0·10	0·08	26·50

SCHEDULE III—*contd.*

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	sugar per cent	Yield					
Circle 21	121	34	19·53	86·20	12·74	10·58	79	24	17·10	79·44	9·78	7·64	1·1	0·10	0·12	0·08	38·50
Circle 22	134	28	19·61	86·01	12·75	10·61	66	16	17·30	80·40	10·03	7·81	0·5	0·05	0·05	·04	33·00
Circle 23	60	18	19·47	86·28	12·72	10·60	40	12	17·06	79·77	9·80	7·72	0·5	0·05	0·05	0·04	40·00
Circle 24	89	25	19·33	85·90	12·57	10·19	111	27	17·38	80·29	10·29	7·85	1·0	0·09	0·10	0·08	55·50
Circle 25	127	42	19·62	86·14	12·79	10·70	73	26	15·66	78·97	8·86	6·79	2·5	0·23	0·27	0·17	36·50
Circle 26	314	123	19·28	86·00	12·53	10·48	186	64	16·86	78·96	9·57	7·42	4·6	0·43	0·48	0·34	37·20
Circle 27	67	29	19·60	86·17	12·80	10·69	33	14	17·03	79·74	9 80	7·67	1·0	0·10	0·11	0·08	33·00
Circle 28	68	18	19·16	85·22	12·40	10·22	32	6	16·96	75·59	9·73	7·56	0·6	0·06	0·06	0·04	32·00
Totals and averages.	7299	2384	19·54	86·17	12·75	10·64	4201	1404	17·06	79 61	9·79	7·61	100·0	9·52	10·66	7·61	36·53

***Factory Results*:—**

Cane crushed during February . . . . 5,15,188 maunds
Sugar made during February . . . . 48,891 maunds
Yield of sugar per cent cane . . . . 9·49 per cent

***Borer Survey*:—**

Yield of sugar from mixed cane . . . . 9·52 per cent
Yield of sugar from sound cane . . . . 10·66 per cent
Yield of sugar from infested cane . . . . 7·61 per cent

Loss of sugar due to borer infestation and disease 5,15,188 × (10·66—9·52)/100 = 5,873 maunds

Schedule IV

Factory No. 4

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1 .	1305	503	20·12	90·79	13·88	12·10	995	416	17·42	81·42	10·26	8·48	30·7	3·21	3·71	2·60	43·26
Circle 2 .	1295	540	19·98	89·92	14·00	12·23	1005	431	18·09	81·94	10·74	8·59	26·5	2·81	3·24	2·28	43·70
Circle 3 .	1409	582	21·41	90·84	14·97	12·89	991	383	17·33	79·39	9·92	7·75	31·2	3·39	4·02	2·42	41·29
Circle 4 .	434	181	20·83	86·79	13·72	11·59	366	155	17·90	76·10	9·89	7·47	11·6	1·13	1·34	0·87	45·75
Totals and Averages.	4443	1806	20·56	90·14	14·25	12·34	3357	1385	17·66	80·43	10·27	8·20	100·0	10·54	12·31	8·17	43·04

Factory Results :—

Cane crushed during February . . . . . 5,15,563 maunds
Sugar made during February . . . 54,761 maunds
Yield of sugar per cent cane . . . . . 10·62 per cent

Borer Survey :—

Yield of sugar from mixed cane . . . . 10·54 per cent
Yield of sugar from sound cane . . 12·31 per cent
Yield of sugar from infested cane . 8·17 per cent

Loss of sugar due to borer infestation and disease 5,15,563 × (12·31 × 10·54)/100 9,125 maunds.

SCHEDULE V

Factory No. 5

Area	Sound cane: No. of stalks	Sound cane: Weight in seers	Sound cane: Brix	Sound cane: Purity	Sound cane: Sugar per cent	Sound cane: Yield	Infested cane: No. of stalks	Infested cane: Weight in seers	Infested cane: Brix	Infested cane: Purity	Infested cane: Sugar per cent	Infested cane: yield	Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
Circle 1 .	1199	560	20·75	85·02	13·95	12·25	801	406	18·05	81 25	11·18	9·39	19·59	2·16	2·40	1·84	40·05
Circle 2 .	936	419	20·94	85·17	14·09	11·99	764	373	18·28	80·63	11·23	9·44	25·63	2·77	3·07	2·42	44·94
Circle 3 .	1038	500	20·90	86·82	14·06	12·33	862	421	19·01	80 50	11·04	9·01	27·63	2·98	3·41	2·49	45·37
Cirlce 4	1009	506	20·65	84·97	13·84	12·03	691	354	17·90	80 22	10·87	9 11	13·79	1·49	1·66	1·26	40·64
Circle 5 .	1284	582	21·34	85·04	14·05	12·26	916	477	19·58	79 10	11·59	9·44	13·36	1·47	1·64	1·26	41·64
Totals and Averages.	5466	2567	20·92	85·29	14·00	12·18	4034	2031	18·62	80·30	11·20	9·28	100·00	10·87	12·18	9·27	42·46

Factory Results :—

Cane crushed during February . . . . 5,95,039 maunds
Sugar made during February . . . . 64,145 maunds
Yield of sugar per cent cane . 10·78 per cent

Borer Survey.—

Yield of sugar from mixed cane . . . . 10·87 per cent
Yield of sugar from sound cane . . . 12·18 per cent
Yield of sugar from infested cane . . . . 9·27 per cent

Loss of sugar due to borer infestation and disease 5,95,039 × (12·18—10·87)/100 = 7,795 maunds

SCHEDULE VI

Factory No. 6

Area	Sound cane: No. of stalks	Sound cane: Weight in seers	Sound cane: Brix	Sound cane: Purity	Sound cane: Sugar Per cent	Sound cane: Yield	Infested cane: No. of stalks	Infested cane: Weight in seers	Infested cane: Brix	Infested cane: Purity	Infested cane: Sugar per cent	Infested cane: Yield	Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
Circle 1	2123	1048	20·22	85·63	13·57	11·36	677	318	18·25	79·83	11·06	9·09	35·89	3·89	4·08	3·26	24·18
Circle 2	1066	433	19·19	81·60	12·38	10·34	734	281	15·82	73·04	8·86	6·73	2·52	0·22	0·26	0·17	40·78
Circle 3	1744	797	19·80	85·21	13·31	11·13	656	290	16·84	77·11	9·83	8·12	15·70	1·62	1·75	1·27	27·33
Circle 4	1505	707	19·28	84·47	13·37	11·38	795	378	16·91	78·81	10·12	8·17	4·26	0·44	0·48	0·35	34·57
Circle 5	1577	733	19·85	84·93	13·32	11·31	623	279	17·53	78·35	10·45	8·39	9·27	0·97	1·05	0·78	28·32
Circle 6	1003	444	19·95	84·13	13·26	11·26	597	247	17·47	78·46	10·44	8·40	2·11	0·21	0·24	0·18	37·31
Circle 7	933	408	19·80	82·64	12·98	10·81	367	150	17·03	75·67	9·76	8·12	13·82	1·39	1·49	1·12	28·23
Circle 8	1423	595	19·69	84·14	13·09	11·12	977	394	17·18	77·03	10·08	8·05	2·61	0·26	0·29	0·21	40·71
Circle 9	980	418	20·00	84·89	13·41	11·27	420	169	17·16	75·96	9·85	8·02	13·82	1·43	1·56	1·11	30·00
Totals and Averages.	12354	5583	19·79	84·47	13·25	11·24	5846	2506	17·14	77·35	10·09	8·13	100·00	10·43	11·20	8·45	32·12

***Factory Results*:—**

Cane crushed during February . . . . . 5,03,377 maunds
Sugar made during February . . . . . 51,924 maunds
Yield of sugar per cent cane . . . . . 10·32 per cent

***Borer Survey*:—**

Yield of sugar from mixed cane . . . . . 10·43 per cent
Yield of sugar from sound cane . . . . . 11·20 per cent
Yield of sugar from infested cane . . . . . 8·45 per cent

Loss of sugar due to borer infestation and disease 5,03,377 × (11·20—10·43)/100 = 3,876 maunds

SCHEDULE VII

Factory No. 7

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1 .	675	280	20·79	88 30	14·01	11·80	520	212	18·71	81·18	11 45	9·30	10·9	1·16	1·29	1·01	43 52
Circle 2 .	856	320	20·95	87·43	13·90	11·70	655	249	19·35	84·36	11·86	9·70	7·6	0·81	0·89	0·74	43·35
Circle 3 .	737	328	20·97	88·94	14·80	12 68	436	184	20·00	85 83	12·60	10·47	20·5	2·44	2·60	2·15	37·17
Circle 4 .	751	282	21·09	88 33	14·13	12 04	404	167	18·96	84 62	11·64	9·60	11·0	1·21	1·32	1·06	34·98
Circle 5 .	732	303	20·81	86·81	13·68	11·53	456	191	19·81	79 15	11·37	10·01	11·3	1·23	1·30	1·13	38·38
Circle 6 .	1012	403	21·15	88·45	14·17	12 02	703	318	19·19	83 21	11·54	9·60	13·8	1·50	1·66	1·32	40·99
Circle 7	234	126	20·95	84·67	13·44	11 04	395	186	17·58	79·49	10·06	7·72	7·3	0·66	0·81	0·56	62·80
Circle 8 .	733	291	20·96	87·10	14·43	12·23	493	216	19·30	84·51	11·83	9·68	8·2	0·91	1·00	0·79	40·21
Circle 9 .	475	269	21·05	86·80	13·91	11·37	598	330	19·34	82·62	11·58	9·76	3·3	0·34	0·38	0·32	55·73
Circle 10 .	534	236	21·16	86·57	14·06	11 83	381	187	19·81	83·45	12·02	9·70	3·3	0·36	0·39	0·32	41·64
Circle 11 .	618	267	21·42	88·95	14·44	12·23	473	198	18·78	85·02	11·60	9·45	2 8	0·31	0·34	0·26	43·36
Totals and Averages.	7357	3100	21·03	87·69	14·13	11·92	5514	2438	19·18	83·04	11·60	9·56	100·0	10·93	11·98	9·66	42·84

Factory Results :—

Cane crushed during February . 5,56,248 maunds
Sugar made during February 59,377 maunds
Yield of sugar per cent cane . 10 67 per cent

Borer Survey :—

Yield of sugar from mixed cane . . . . 10·98 per cent
Yield of sugar from sound cane . . . 11·98 per cent
Yield of sugar from infested cane . . . 9·66 per cent

Loss of sugar due to borer infestation and disease 5,56,248 × (11·98—10·93)/100 = 5,841 maunds

SCHEDULE VIII

Factory No. 8

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	yield					
Circle 1 .	901	433	20·36	87·94	13·59	11·59	199	72	18·82	86·26	11·81	9·74	30·12	3·42	3·49	2·93	18·09
Circle 2 .	906	422	20·44	88·12	13·67	11·68	194	69	18·81	86·71	11·87	9·99	23·96	2·74	2·80	2·39	17·64
Circle 3 .	734	362	20·23	87·69	13·46	11·46	166	50	18·42	85·98	11·51	9·64	19·24	2·15	2·20	1·85	18·44
Circle 4 .	887	447	20·29	87·93	13·55	11·57	213	86	18·84	86·51	11·86	9·97	4·02	0·45	0·47	0·40	19·36
Circle 5 .	918	448	20·30	87·79	13·50	11·49	182	68	18·91	86·33	11·88	9·98	3·51	0·39	0·40	0·35	16·55
Circle 6 .	660	304	20·15	87·97	13·54	11·55	140	52	19·00	86·70	11·98	10·11	7·65	0·86	0·88	0·77	17·50
Circle 7 .	730	335	20·55	87·59	13·67	11·63	170	60	18·99	86·10	11·89	9·97	9·54	1·08	1·11	0·95	18·89
Circle 8 .	700	369	20·24	87·98	13·51	11·55	200	80	18·61	86·63	11·72	9·89	1·96	0·22	0·23	0·19	22·22
Totals and Averages.	6436	3120	20·32	87·88	13·56	11·57	1464	537	18·80	86·42	11·82	9·91	100·00	11·31	11·58	9·83	18·53

Factory Results:—

Cane crushed during February . . . . . 4,70,693 maunds
Sugar made during February . . . . . 53,027 maunds
Yield of sugar per cent cane . . . . . 11·26 per cent

Loss of sugar due to borer infestation and disease 4,70,693 × (11·58—11·31)/100 = 1,271 maunds

Borer Survey:—

Yield of sugarf rom mixed cane . . . 11·31 per cent
Yield of sugar from sound cane . . . . 11·58 per cent
Yield of sugar from infested cane . . . . 9·83 per cent

SCHEDULE IX

Factory No. 9

Area	Sound cane						Infested cane						Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield	No. of stalks	Weight in seers	Brix	Purity	Sugar per cent	Yield					
Circle 1 .	418	184	20·06	88·09	13·27	11·29	132	63	18·19	80·09	10·56	8·52	6·4	0·68	0·72	0·55	24·00
Circle 2 .	454	229	20·03	88·07	13·31	11·32	96	52	18·30	81·62	10·86	8·83	15·1	1·64	1·71	1·33	17·45
Circle 3 .	319	159	19·87	88·46	13·08	11·09	81	34	18·37	80·74	10·67	8·62	11·7	1·25	1·30	1·01	20·25
Circle 4 .	347	161	20·35	87·89	13·28	11·31	53	24	19·16	81·56	11·40	9·38	2·3	0·25	0·26	0·22	13·25
Circle 5 .	158	83	20·21	89·48	13·45	11·48	42	20	18·98	81·58	11·24	9·23	4·7	0·52	0·54	0·43	21·00
Circle 6 .	289	132	20·01	88·96	13·22	11·24	61	32	19·33	84·11	11·96	9·93	2·9	0·32	0·33	0·29	17·43
Circle 7 .	498	252	19·82	88·24	12·95	10·98	102	31	19·23	83·40	11·63	9·59	6·7	0·72	0·74	0·64	17·00
Circle 8 .	571	331	19·93	87·61	12·94	10·95	129	65	18·89	80·51	11·11	9·05	16·3	1·75	1·78	1·48	18·43
Circle 9 .	576	289	19·91	88·08	13·00	11·12	124	59	18·69	81·88	11·14	9·10	7·7	0·83	0·86	0·70	17·71
Circle 10 .	504	245	19·34	87·85	12·31	10·34	96	49	18·80	82·33	11·32	9·28	9·5	0·96	0·98	0·88	16·00
Circle 11 .	80	42	19·69	89·43	13·07	11·13	70	31	18·77	84·85	11·57	9·52	10·9	1·14	1·21	1·04	46·67
Circle 12 .	399	185	19·47	89·37	12·91	10·95	151	79	17·52	81·64	10·35	8·31	5·8	0·59	0·64	0·48	27·45
Totals and Averages.	4613	2292	19·87	88·25	13·01	11·05	1137	539	18·54	81·78	11·03	8·99	100·00	10·65	11·07	9·05	19·77

Factory Results :—

Cane crushed during February . . . . . 4,68,564 maunds
Sugar made during February . . . . . 49,941 maunds
Yield of sugar per cent cane . . . . . 10·66 per cent

Borer Survey :—

Yield of sugar from mixed cane . . . . 10·65 per cent
Yield of sugar from sound cane . . . . 11·07 per cent
Yield of sugar from infested cane . . 9·05 per cent

Loss of sugar due to borer infestation and disease 4,68,564 × (11·07—10·65)/100 = 1,968 maunds

SCHEDULE X

Factory No. 10

Area	Sound cane: No. of stalks	Sound cane: Weight in seers	Sound cane: Brix	Sound cane: Purity	Sound cane: Sugar per cent	Sound cane: Yield	Infested cane: No. of stalks	Infested cane: Weight in seers	Infested cane: Brix	Infested cane: Purity	Infested cane: Sugar per cent	Infested cane: Yield	Proportion per cent total supplies	Average per cent yield mixed cane	Average per cent yield sound cane	Average per cent yield infested cane	Percentage infestation on No. of stalks
Circle 1	433	157	20·12	87·05	13·72	11·61	197	70	18·13	83 62	11·52	9·36	5·13	0·57	0·60	0·48	31·27
Circle 2	414	149	19·78	87·89	13·73	11·76	176	68	18·18	83·19	11·50	9·28	2·87	0·32	0·34	0·27	29·83
Circle 3	469	156	19·75	88·28	13·74	11·72	182	53	18·35	84·55	11·24	9·01	7·36	0·81	0·86	0·66	27·96
Circle 4	479	165	19·81	87·60	13·71	11·68	144	53	18·35	82·32	11·50	9·25	5·14	0·57	0·60	0·48	23·11
Circle 5	399	198	20·30	87·74	14·06	11·89	213	89	18·20	81·27	11·27	8·93	7·64	0·82	0·91	0·68	34·80
Circle 6	404	192	19·93	87·31	13·96	11·85	210	91	18 32	79·87	11·16	8·70	5·15	0·55	0·61	0·45	34·20
Circle 7	364	166	20·25	86·65	13·85	11·66	252	121	18·03	81·97	11·24	8·98	4·94	0·61	0·58	0·44	40·91
Circle 8	303	131	20·21	87·04	13·90	11·73	106	51	19·20	84·21	12·29	10·03	2·64	0·30	0·31	0·26	25·61
Circle 9	549	239	19·86	88·36	13·29	11·33	166	73	18·61	83·24	11·25	9·04	6·09	0·66	0·69	0·55	23·22
Circle 10	476	217	20·25	87·68	13·48	11·51	230	102	18·57	85·13	12·02	10·02	5·74	0·63	0·66	0·58	32·58
Circle 11	488	199	19·87	87·91	13·80	11·77	248	130	17·92	83·40	11·36	9·24	7·17	0·79	0·84	0·66	33·70
Circle 12	491	300	19·80	87·88	13·98	11·96	201	96	18·67	85·20	12·09	10·04	4·01	0·46	0·50	0·40	29·05
Circle 13	547	216	20·11	88·12	13·99	11·98	169	62	18·62	85·02	12·05	9·98	4·63	0·54	0·55	0·46	23·60
Circle 14	494	215	20·27	87·93	14·11	12·07	223	104	19·22	83·22	12·14	9·81	4·91	0·56	0·59	0·48	31·10
Circle 15	493	156	20·81	87·73	13·85	11·63	191	76	19·55	82·19	11·67	9·10	9·92	1·07	1·15	0·90	27·92
Circle 16	428	162	20·68	86·46	13·52	11·20	265	99	19·05	83 10	11·49	9·20	16·69	1·74	1·87	1·54	38·24
Totals and Averages.	7236	3018	20·09	87·66	13·80	11·72	3173	1338	18·53	83·15	11·60	9·36	100·00	10·90	11·66	9·29	30·48

Factory Results :—

Cane crushed during February . . . . . 4,91,191 maunds
Sugar made during February . . . . . 52,593 maunds
Yield of sugar per cent cane . . . . . 10·71 per cent

Loss of sugar due to borer infestation and disease 4,91,191 × (11·66—10·90)/10 = 3,733 maunds

Borer Survey :—

Yield of sugar from sound cane . . . . 11·66 per cent
Yield of sugar from mixed cane . . . . 10·90 per cent
Yield of sugar from infested cane . . . . 9·29 per cent

SCHEDULE XI

	Factory No. 1		Factory No. 2		Factory No. 3		Factory No. 4		Factory No. 5		Totals and averages	
	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938
Total number of stalks examined	5,300	10,390	8,500	13,100	4,500	11,500	3,400	7,800	2,150	9,500	23,850	52,290
Total No. of infested stalks	2,580	4,434	2,941	4,235	1,567	4,201	1,903	3,357	865	4,034	9,856	20,261
Degree of infestation	48·68	42·68	34·60	32·33	34·80	36·53	55·97	43·04	40·00	42·46	41·32	38·75
Weight in seers per 2,000 stalks (sound)	778	676	662	548	836	654	986	814	1,092	940	797	699
Weight in seers per 2,000 stalks (infested)	837	721	668	546	839	668	950	825	1,080	1,007	830	748
Purity of extracted juice (sound cane)	86·34	85·85	83·59	84·25	86·77	87·17	86·45	90·14	85·78	85·29	85·74	86·48
Purity of extracted juice (infested cane)	81·08	80·35	78·35	79·26	78·94	79·61	74·91	80·43	81·11	80·30	79·01	79·99
Sugar per cent sound cane	13·23	13·20	12·68	13·04	12·76	12·75	13·27	14·25	13·07	14·00	13·00	13·45
Sugar per cent infested cane	10·84	10·80	10·12	10·30	9·23	9·79	8·22	10·27	10·11	11·20	9·76	10·50
Estimated sugar yield from sound cane	11·27	11·42	10·57	10·81	10·76	10·66	11·23	12·31	11·52	12·18	11·08	11·48
Estimated sugar yield from infested cane	8·96	8·93	8·05	8·22	6·98	7·61	6·16	8·17	8·30	9·27	7·76	8·47
Estimated sugar yield from mixed cane	10·13	10·35	9·76	10·02	9·38	9·52	8·48	10·54	10·15	10·87	9·62	10·27
Actual factory yield of sugar	10·05	10·25	9·68	10·01	9·56	9·49	8·64	10·62	10·10	10·78	9·64	10·24
Maunds cane crushed	5,88,537	5,71,581	5,85,136	5,84,710	5,02,596	5,15,188	5,10,920	5,15,563	6,13,251	5,95,039	28,00,440	27,82,081
Maunds sugar lost due to infested cane	6,709	6,116	4,740	4,619	6,936	5,873	14,053	9,125	8,401	7,795	40,839	33,528

Schedule XII

	Factory No. 6		Factory No. 7		Factory No. 8		Factory No. 9		Factory No. 10		Totals and averages	
	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938
Total number of stalks examined	7,168	18,200	1,980	12,871	2,700	7,900	1,800	5,750	2,573	10,409	16,221	55,094
Total No. of infested stalks	2,230	5,846	904	5,514	468	1,464	437	1,137	676	3,173	4,715	17,184
Degree of infestation	31·11	32·12	45·66	42·84	17·33	18·53	24·28	19·77	26·27	30·48	29·09	31·10
Weight in seers per 2,000 stalks (sound)	972	902	828	844	984	970	1,308	992	1,210	834	1,040	900
Weight in seers per 2,000 stalks (infested)	922	857	846	882	800	734	1,198	984	1,112	843	949	858
Purity of extracted juice (sound cane)	87·22	84·47	87·75	87·69	87·29	87·88	89·45	88·25	85·96	87·66	87·57	87·17
Purity of extracted juice (infested cane)	80·48	77·35	81·38	83·04	84·63	86·42	84·10	81·78	84·09	83·15	82·81	82·31
Sugar per cent sound cane	12·94	13·25	12·88	14·13	12·76	13·56	13·34	13·01	12·92	13·80	12·97	13·57
Sugar per cent infested cane	9·78	10·09	10·74	11·60	10·46	11·82	10·12	11·03	11·43	11·60	10·50	11·23
Estimated yield from sound cane	10·84	11·20	10·84	11·98	10·74	11·58	11·39	11·07	10·83	11·66	10·93	11·51
Estimated yield from infested cane	7·65	8·45	8·56	9·06	8·60	9·83	8·13	9·05	9·37	9·29	8·45	9·26
Estimated yield from mixed cane	9·86	10·43	9·67	10·93	10·47	11·31	10·62	10·65	10·47	10·90	10·19	10·84
Actual factory yield of sugar	9·67	10·32	9·81	10·67	10·63	11·26	10·49	10·66	10·50	10·71	10·18	10·72
Maunds cane crushed	5,18,803	5,03,377	5,96,258	5,56,248	4,28,518	4,70,698	5,04,128	4,68,564	4,74,309	4,91,191	25,17,016	24,90,078
Maunds sugar lost due to infested cane	5,035	3,876	6,738	5,841	1,157	1,271	3,882	1,968	1,708	3,733	18,520	16,689

THE PROBLEM OF ANIMAL NUTRITION IN INDIA*

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INTRODUCTION

THE unique place which human nutrition occupies in relation to preventive medicine and public health is also the legitimate position which animal nutrition should occupy in relation to veterinary science and animal husbandry. While the importance of the former combination has been recognised, the significance of the latter has so far attracted but little attention in India.

It is obvious that in any sound scheme of human economy, the animal must play a predominant part. It provides man with his food, clothing and power for tillage and locomotion. While it may be possible for advanced Western countries to replace the animal's wool by artificial fibre and its labour on the road and the field by suitable motor tractors, all that many years of mechanization can do in India is barely to replace it as a means of locomotion.

To comprehend the immensity of the problem it is necessary to understand that the cattle population in India, including buffaloes, is about 57 per cent of the human, while inclusive of the other domestic animals such as sheep, goats, horses, etc., it amounts to about 85 per cent of the human population. On the credit side of the activities of this animal population are (*a*) the export trade of India which consists mainly of agricultural products such as jute, rice, wheat, cotton, and oil seeds, (*b*) the food crops consumed by the human population, (*c*) milk and milk products yielded by them, (*d*) wool produced by sheep, however small the yield may be, (*e*) beef, mutton and goat's meat which go into the human dietary, (*f*) hides

*This is the eleventh of a series of popular articles for practical farmers on various animal husbandry subjects of general interest.

and skins which form an important export of India and (*g*) the return to the land of a good part of the feed in the shape of valuable manure. The animals receive in exchange the crop stubbles from cultivated areas, the aftermaths on these fields in the shape of weeds or other plants, the grasses on field borders or along water-courses and the uncultivated scarce pasturage of poor quality on the natural grazing lands near villages. The feeding of concentrates is practised by so few cattle-owners as to be almost negligible.

Such balancing of the public health and national prosperity of India on the slender back, or perhaps more appropriately on the half-fed stomach, of its mercilessly exploited cattle population has the appearance of the impossible. The fact that the burden is carried does not indicate competence to do so on its part. The inadequacy of feeding and care is too apparent to allow of any such conclusion.

An attempt is made in this paper to consider a proper scheme for the nutrition of our animal population with special reference to farm-stock, so that the keeping of a good stock of animals in optimum health might enable our national health and wealth to rest on surer foundations.

FODDER RESOURCES OF INDIA. THE QUESTION OF SUPPLY AND DEMAND

The adequate nutrition of an animal involves the provision of a sufficiency of the three proximate principles, protein, fats and carbohydrates. Water and salts form an equally necessary requirement This is not to presuppose that the other accessory constituents of food such as the vitamins, amides, lecithins, cholesterol or the lipochrome pigments are unessential. It is established that all these constituents of food are necessary for the proper nutrition of animals and that an excess of any one, or any groups of these substances will not compensate for the entire absence of any of the others, however microscopic the requirement of the animal for that particular ingredient may be.

The roughage feed of animals is important in more than one way. It supplies animals with the energy required to carry on the vital processes of life and enables them to maintain body temperature, besides providing the energy requirements for work and milk production. Being a bulky food it gives the animal a feeling of fulness after a meal. The large quantities of cellulose and other indigestible material in it help to promote proper peristaltic movements. Further, the excess amounts of the digestible carbohydrates are stored by the animal system as fats, which form its main source of reserve energy in times of need. The provision of a sufficiency of carbohydrates, however, seems at first sight to be an easy matter, since the bulk of all plant material consists of these substances.

According to recent census figures there are in the whole of India 201 million head of cattle alone. Allowing a maintenance requirement of 10-12 lbs. of dry matter per head per day, the average requirement of the cattle population of this country is in the neighbourhood of 365 million tons of fodder (dry matter) per

annum. To set off against this demand we have at present a net cultivated area of 300 million acres, 60 million acres of current fallow, and making allowance for all other accessible sources of cattle fodder, an additional 170 million acres of cultivable waste. These together make an aggregate of 530 million acres from which our cattle obtain, under maximum exertion from man and beast, their wherewithal to maintain themselves. Now, Western estimates of the yield of hay or straw from natural grazing lands approximate to one ton of dry matter per acre. Indian estimates of the straw and other herbages available from cultivated lands put it at about thirty maunds per acre, which is also a little over one ton per acre. This is to say that to meet the demand for 365 million tons of fodder, there is an available source of 530 million tons. This represents a fifty per cent excess over the maintenance requirement of our cattle population.

Two important factors have to be reckoned with in this connection. One is the fact that the maintenance allowance of ten to twelve lbs. of dry fodder per head of cattle does not include the energy involved either in the yield of milk by cows or in the output of work by the working animals. Milch animals and animals at work are known to consume two or more times the quantity of feed which an animal at rest would require. The other important fact is that, in the above computation of the animal requirements of fodder, no account has been taken of the fodder supply necessary for our other domestic animals such as sheep, goats, horses, and camels. Excluding pigs and poultry, their population amounts to nearly 100 million head. The above considerations show that the situation regarding the supply of bare roughage for our animal population, irrespective of its quality, is so deficient in quantity that it does not justify neglect of the problem of animal nutrition in this coutnry.

Protein deficiency in Indian roughages

Assuming it possible by suitable land husbandry to secure animals against this state of semi-starvation, is the available fodder good enough to fulfil their requirements for other constituents of food ? A sufficiency of protein in the feed of an animal is an indispensable factor. It supplies the necessary material for building up the body and to repair the basal catabolic wastage of the body tissues day by day. As a result of numerous experiments conducted at the Animal Nutrition Section, Izatnagar, it has been estimated that a 1,000-lb. bullock at rest would require about 180 grms. of digestible crude protein per day to maintain itself in nitrogen equilibrium. On the basis of a 600-lb. body-weight for an average animal it requires about 108 grms. of digestible crude protein for mere maintenance purposes. As has been already stated, the fodder available to cattle in this country mainly consists of the cereal straws and stubbles, and the dried herbages which remain on cultivated lands after harvest, and also the over-ripe dried grasses which pass as hay. Some of these grasses, cut at the proper stages and cured into hay, are quite good as cattle fodder, their protein content in tender cuttings being

as high as 18 per cent. Under the present practical conditions of cattle feeding obtaining in this country, their crude protein content is less than about 3 per cent and their digestible protein content often lower than in cereal straws. In most cases, the dry roughage available can be assumed, for purposes of nutritive value, to contain no significant amount of digestible crude protein. In any case, the ten to twelve lbs. of straw or hay, that may be available for the average cattle by improving the sources of supply, cannot supply more than 0·06 lbs. of digestible crude protein, whilst the animal needs four or more times that amount. No account has yet been taken of the protein requirements of young stock for their growth and of milch animals for milk production. Foreign estimates provide a maintenance ration of 0·6 lbs. of digestible crude protein and another equal quantity for the production of 10 lbs. of milk. Thus, the protein provided for the average animal in India is less than its requirement for simple maintenance, excluding the extra amounts required for flesh formation and milk production.

Mineral requirements

Having considered the energy and protein requirements of animals, it is natural that the supply of their skeletal substances is also assessed. It is known that 90 per cent of the skeleton of animals is made up of lime and phosphorus. While an excess of these mineral constituents is deposited in the bones, the skeleton is depleted of its lime and phosphorus if the animal's feed is deficient in these ingredients. Such a depletion is known to produce porosity and brittleness of bone. The need of growing animals for these minerals is more than that of adults, while the requirement of milking animals is considerably greater. It has been estimated, both in India and foreign countries, that the minimum requirement of a 750-lbs. animal would be about fifteen grms. of lime and ten grms. of phosphoric acid per day. Normally, the cereal straws are not poor in these minerals, but those grown on certain acidic soils may suffer from a minor deficiency. A lime content of 0·3 per cent in the fodder will supply the minimum requirements of lime if the animals consume about ten to twelve lbs. of roughage per day. But the same fodder may just fail to contain the optimum quantity of phosphoric acid, which imbalance will upset the proper assimilation of both the minerals. Deficiency of minerals in the feed of animals and their reaction on their normal health and production have been extensively studied in farm animals. It has been observed that most fodders and good pastures contain considerable quantities of minerals and that they are duly balanced in regard to all minerals. Emphasis has, however, been laid on the lime/phosphorus ratio. For best assimilation a ratio of 1·3—1·5 of lime to 1 of phosphoric acid has been found to be most suited, an excess of phosphorus resulting in the wastage of both. When the quantities present in the feed are abnormal the ratio is not significant. It has been found that with minimal quantities of lime and phosphorus an associated deficiency of vitamin-D will produce rickets in some animals and a low phosphorus intake produces a disease,

osteomalacia, in bovines. Mention should also be made that the conditions favourable to their utilization diminish with the advancing maturity of the crops. From the foregoing it may be concluded that while the chances of direct acalcicosis are few, there is always the likelihood of an indirect disturbance to the lime and phosphorus metabolism.

So far we have discussed the inadequacy of the feeding available to our live-stock from the standpoint of the major ingredients in their foodstuffs. It has already been stated that there are very small quantities of substances, mineral as well as organic, which play their own important roles in the proper nutrition of animals. Our knowledge regarding the occurrence, nature and necessity as also the utilisation and quantitative requirements of these small factors by animals is so uncertain in regard to Indian conditions, that no attempt can be made in this article to relate these to the entire animal population of this country. Their necessity and importance to cattle have, however, been demonstrated by clinical conditions that result from a deficiency of these substances in their dietary, either partial or complete, single or combined. The radical change in outlook which nutritional studies have undergone as the outcome of these qualitative factors makes it necessary that these conditions are considered in regard to the proper nutrition of cattle in India. On mineral ingredients, considerable amount of work has been done. A lack of iodine in the diet is found to be the cause of goitre and the " hairless pig malady ". An iron deficiency in the food results in primary anaemia. Copper, manganese and other rare elements in cattle fodder have also been studied, but so far no definite information is available on specific deficiency diseases attributable to them.

The vitamin problem in animal nutrition

The role of vitamins has been more intensively studied with reference to human dietary than with regard to feeding live-stock. Recent work on deficiency diseases due to absence of vitamins in diet has shown that unnoticeable shortages of these valuable substances may also result in complicated diseases. It has been pointed out that a vitamin-A deficiency in the food can cause a retardation of growth, eye diseases from mild ophthalmias to atrophy of the eyeballs and loss of lenses, lung diseases, kidney and other stone deposits. Severe diarrhoea in calves, ophthalmia in growing animals and premature expulsion of foetus or birth of dead or weak calves with nervous disorders have been observed in cattle due to vitamin-A deficiency. Closely associated, in solution in the fats of green young plant material, is the substance known as vitamin-D, which plays an important part in the metabolism of bones and various disorders connected with the skeletal tissues. Reproduction is closely linked with the presence of vitamin-E which again is fat soluble. Lack of this vitamin is known to cause a degeneration of the germ cells in the testes of the male, while in the female, foetuses are resorbed. Some unsaturated fatty acids, such as linoleic acid, have also been found essential for the

prevention of a certain deficiency disease, akin to pellagra. These acids go under the name vitamin-F. Incidentally, the importance of the fat in the feed of farm-stock becomes more apparent as the carrier of these valuable accessory substances.

Of the other vitamins, vitamin-B, has been found to be necessary for the prevention and cure of polyneuritis, loss of appetite and gastro-intestinal troubles. This vitamin is, however, known to be synthesized in the cattle system and hence it is not so essential as the others. Vitamin-B_2 or G as it is also called, is known by the dermatitis, mouth lesions and cataract formation that result from its absence in the dietary. Loss of reflexes also develops if the deficiency is prolonged. Vitamin-C, the principle present in fresh fruits, vegetables and leaves, is identified by the diseases produced by its absence from the food, such as sore gums and joints, loose teeth and eventually capillary haemorrhages. The list of vitamins is, however, continuously expanding, lending support to the view that the last word has not yet been said on the factors that determine the nutritional health of an animal.

It may generally be said that the liability of farm-stock, under natural conditions, to diseases due to the complete absence of any of these vitamins is less than in the case of human or other animals. All ruminants subsist, at least for a small part of the year, on fresh green pasture which generally provides an excess of these constituents. It is, however, possible in many cases that the supply or the reserve falls short of the optimum and yet enables the animal to carry on under minor degrees of malnutrition

Nutrition in relation to intensive production

There is another aspect of the problem of nutrition among the cattle of this country which has not yet been touched upon. With the changed circumstances in Indian life, there has been a progressive exodus of the human population from the villages to the cities of India, mostly in pursuit of occupation. It is but natural that the concentration of the human population in cities must bring about a similar concentration of the necessary auxiliary animal population, chiefly milch animals. The average Indian is quite aware of the value or utility of cows' milk for the proper nutrition of human beings. If the average consumption of milk and milk products in India is much lower than in other countries, it has to be attributed to two limiting factors, (*i*) the poor capacity for production of our cows which raises the prices of these commodities and (*ii*) the poorer purchasing capacity of the average Indian. The average city dweller's capacity to purchase either milk or other necessities of life is decidedly higher than that of an average villager. The exodus of a large number of milch cattle to cities to meet this demand for dairy produce has been responsible for the development of what may be called dairies in and around these cities. The problem of nutrition so far considered by us related only to animals kept by the individual householder, who has no idea of making his cow or she-buffalo an economic proposition, since their products are mainly

intended for home consumption. The case would be a little different in villages situated within easy reach of a town. It is a fact that the problems in respect of keeping a number of milch animals as a business organization and their proper care and feeding, have arisen only with the rapid growth of cities.

The intensive stock-keeper's problems are somewhat different. It has been estimated that the consumption of milk in towns such as Bombay, Calcutta and Poona is 7—8 gallons per annum or 3—3½ ounces per day per head of human population. About four-fifths of the entire milk supplies of these towns comes from animals which are stabled within the city. It can be assumed that these animals lose all the benefits of a natural life in the open. The stall feeding of cattle under the insanitary conditions obtaining in large towns (particularly with the object of forcing the animals to intensive production), often results in diseases attributable to nutritional and metabolic disorders.

If dairy animals are fed on cultivated pasture crops there is no likelihood of any mineral deficiency. For instance, cows' milk has been known to contain 2·38 grms. of CaO and 3·43 grms. of P_2O_5 per 1000 calories, while highly manured pasture contained 9·13 grms. of CaO and 3·68 grms. of P_2O_5. But the problem of deficiency must arise where roughage of poor quality has to be supplemented by cereals and oil cakes for forcing greater production. As a matter of fact the excess concentrate feeding, by a temporary stimulus to growth, is often likely to mask this deficiency in the diet. While the occurrence of rickets and osteomalacia is attributable to a deficiency of calcium and phosphorus in the diet of animals, it is quite probable that the conditions known as acetonaemia and milk-fever are also the results of a mineral deficiency. The intensive stock-keeper thus has to guard against both these nutritional and metabolic disorders.

While opinion holds that in farm animals, under natural conditions of grazing where green fodder is available, much anxiety need not be bestowed on diseases due to vitamin deficiencies, it also holds that for animals kept in stalls more appropriate to laboratory than to field conditions, the problem assumes considerable importance. It cannot be gainsaid that in intensive stock-keeping under the conditions obtaining in the cities of India, conditions of rearing are highly artificial. With the increased concentrate feeding that is generally resorted to in order to force more and more milk, both the quality of roughage and their consumption by the stall-fed animals are likely to be neglected, so that their feeding, though rich, may be unbalanced in several respects.

In this connection attention may be paid to the disease called grass-tetany, which is characterised among other symptoms, by nervousness and a subsequent nervous break-down akin to epilepsy. It is noteworthy that the cattle of orthodox farmers seldom suffer from this disease, yet it occurs in places where improved methods of feeding and manuring are adopted, and is generally observed during

the first two weeks the cows are put on to grazing. Although the etiology of the disease is difficult to define, it is agreed that the excess amount of young and quick growing grass, grown as a result of heavy manuring, which the animal voraciously consumes when freshly put on to it after its winter-rationing on cereals and oil cakes (poor in minerals), are the factors responsible for this disease.

The ideal feed—a balanced diet

Having dealt with the animal requirements of protein, fat, carbohydrate, minerals and vitamins from a forage plant, something has still to be said about the plant. There is still a good deal of material left in the plant which future research may prove to be of high biological value. The mass and variety of interesting information available on these qualitative aspects of nutrition may even induce the belief among stock-feeders that these substances are by themselves capable of stimulating health, growth or production. On the other hand the addition of any of these substances can be of use only in correcting a diet which is deficient in that particular ingredient and can be effective in improving either health, growth or production only to that extent and no more ; further increases in intake being liable to cause positive harm. It cannot be ignored that a balanced ration and a sufficiency of it still remains the ideal, all new additions to our knowledge being helpful in arriving at that ideal. The advantages of an ideally balanced diet would definitely ensure against a deceptive state of apparent health in animals, actually suffering from minor undetectable degrees of malnutrition. Such inhibited conditions would reduce the animal's capacity to resist infective diseases. In an animal under ideal conditions of nutrition, which means health, the susceptibility to infection is counterbalanced by the resistance of the system to infection, so that the animal would become less liable to contract infectious diseases.

Aim of breeders : not numbers—but efficiency

In suggesting ways and means by which our cattle population may be brought nearer the ideal represented by an adequate nutrition, it has to be recognized that the chief requirement of the Indian cultivator is a hardy work animal. He must, therefore, regard the cow primarily as the source of his work cattle, and only secondarily as a milk producer. Where there is a large demand for milk and milk products, the buffalo has been mainly responsible for that supply and not the cow.

A comparison of the cattle population including buffaloes reveals the fact that per 100 acres of net area sown, India maintains sixty-seven head of cattle, while Egypt has only twenty-five, the general condition of agriculture in the two countries being very similar. These figures may be taken as an index of the efficiency of our cattle for work purposes, especially as a large percentage of the land in Egypt is double-cropped. The efficiency of milk production per head of Indian cattle shows an even worse comparison, the average milk yield of a cow and a she-buffalo being 600 lbs. and 1,200 lbs. per annum respectively. With the rapid increase of human population there is an enhanced demand for food crops as well as

for dairy produce. To meet this demand with our inefficient live-stock, the cultivator and the dairy man keeps a greater number of animals. It is not realised that if a certain amount of fodder can maintain 100 animals of 1,000-lbs. live-weight each, the same amount of fodder cannot maintain 200 animals of 500-lbs. live-weight. The result is that the fodder problem is rendered more and more acute. This situation should be arrested by increasing the efficiency of the existing animals instead of increasing their numbers.

Improving the fodder resources by scientific conservation

An important step in increasing the efficiency of our animals is the provision of an adequate food supply. It has been stated earlier that the available coarse fodders in the country are not sufficient to maintain its large animal population. It is also known that most natural grasses, when in fresh green condition, are of great value in the proper nutrition of cattle. In addition to the existing grazing lands, there are extensive areas in India, classified as forests and land not available for cultivation. During the monsoon periods of the year, these areas grow quite an abundance of good quality fodder. Experiments have shown that scientific preservation of green fodder, as silage or as hay, results in products which have a high nutritive value in the feeding of cattle. The application of such methods of conservation on a large scale to the excess of green fodder grown during the monsoon periods should make it possible to increase our fodder supply considerably and thus bring about a great improvement in the condition of our animal population.

THE ORGANISATION OF VETERINARY WORK IN GERMANY

BY

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Having been sent as a delegate by the Imperial Council of Agricultural Research to the World's Dairy Congress, which was held in Berlin in August 1937, I took the opportunity, with the generous help of our Veterinary colleagues in Germany of seeing something of the organisation which exists in that country for the training of Veterinary students, the control of contagious and communicable diseases and the improvement of live-stock generally.

All these subjects are of the greatest interest to us in India, and in particular I was immensely impressed by the German Veterinary Colleges, for it is difficult to visualize anything more complete than the facilities provided for the training of Veterinary students in Germany.

There are five Veterinary Colleges or High Schools in Germany, *viz.*, Berlin, Leipsig, Hannover, Munich and Geissin, and of these I had the pleasure of visiting the three first named. The course extends to five years in each of them. They are all affiliated with the local University, in which they are given a separate Veterinary faculty, except Hannover, where there is no University. This Institution, therefore, works as a High School and grants its own diplomas, but I was assured that no distinction was drawn between the value of this diploma and that of the other Colleges.

Within each College or High School, the different subjects are grouped together in separate self-contained Institutes, or as we should call them departments, each with its own Director. One of these Directors acts as Rector or Principal of the College, in addition to his other duties. Each of these Institutes is housed in a separate building, and supplied with its own lecture rooms, practical class rooms, museum, library and wards, or other appendages appropriate to the work to be performed.

Although no doubt a certain amount of research work is in progress at all the Colleges, it is only at the Berlin College that special facilities for this are provided. This probably accounts for the fact that the number of separate Institutes

in this College amounts to as many as fourteen, while at the other Colleges the number is about ten or twelve. A normal grouping of the subjects may be taken as follows :—

1. Histology and Anatomy;
2. Physiology including Nutrition;
3. Pharmacology including Materia Medica;
4. Zoology and Parasitology;
5. Pathology;
6. Hygiene and Microbiology;
7. Genetics and Breeding including a Dairy;
8. Large animal Medical Clinic;
9. Large animal Surgical Clinic;
10. Small animal Clinic; and
11. Milk and Food Inspection.

Consideration of the above list of subjects will show the comprehensive character of the course at German Veterinary Colleges, and the fact that separate Institutes are provided for Animal Nutrition and Animal Genetics emphasizes the stress that is laid on the study of the physiological as well as the pathological side of our subject. Moreover the provision of a dairy at each College enables the students to be brought into daily contact with the healthy in addition to the diseased animal.

For the prosecution of research into virus diseases, particularly Foot and Mouth disease, and the preparation of suitable biological products for their control, a special research station has been set up on the Island of Reims, off the north coast of Germany, and a visit to this inevitably reminded one of the Mukteswar Institute in India, for the two Institutes have very much in common. As communication with the mainland is allowed only by special permit, special arrangements have to be made for housing and feeding the staff, providing them with recreation and disposal of sewage and waste products from the Institute. Foot and Mouth disease serum is made on a large scale, the serum makers (Freisian bullocks) being hyperimmunised against Types O, A and C of the virus and then bled out and their carcasses dressed and sold for beef. Very special arrangements, by which the animal is kept on one side of a wall and the serum collected on the other, had to be devised before a sterile serum could be obtained, but this is now the order of the day. The serum is stored in a cool room in large glass

containers and tested periodically for sterility. The serum is not used after two years of storage. The virus is maintained and the serum is titrated in guinea pigs.

Other diseases under study at this research Institute are Swine Influenza and what in Germany is called Infectious Bronchitis of horses. The latter appears to be the same primary condition, caused by a virus, which is met with in Remount Depots and amongst cavalry units in India, and it is suggested that such conditions as Pleuro-Pneumonia, Paddock Fever, etc., are secondary to this, and will not occur if the animals are kept perfectly quiet.

The routine examination and diagnosis of morbid material is divided amongst two classes of Institutes, that from milk, meat and food intended for human consumption is sent to the Institutes of Milk and Food Control at the different Veterinary Colleges, where these are available, and in this connection it may be observed that all food animals in Germany are slaughtered in public slaughter-houses which are administered by the Veterinary Department, which is also responsible for the inspection of other foodstuffs such as fish, eggs and milk, the only exception being the chemical analysis of milk.

Material from animals in the field, suspected to be suffering from certain scheduled conditions, *e.g.*, Tuberculosis, Bang's disease (Contagious Abortion), Sterility, etc., and for the diagnosis of equine pregnancy is dealt with in special Institutes, which have been set up for this purpose in convenient centres. These Institutes also act as the distributors for Foot and Mouth disease serum and other biological products and they undoubtedly play a large part in the good results which are being obtained in the control of the above mentioned conditions. For the diagnosis of cases of Tuberculosis, in which the organisms are not demonstrable in the milk, the examination of sputum from the trachea is relied upon. The use of vaccines in the treatment of bovine contagious abortion is prohibited in Germany, yet by efficient methods of diagnosis and hygienic measures in the sheds, certain areas are already declared to be free of the disease.

Mares which have proved barren for two years in succession are required to be reported to the Veterinary authorities for investigation of the cause and all stud animals have to be certified as fit for breeding purposes by a Veterinary Officer before they are registered.

The head of this official Veterinary Organisation holds a position in the Ministry of the Interior exactly analogous with the head of the Public Health Department, an arrangement which gives Veterinarians in Germany a status which is not found in many other countries.

It must not be thought, however, that Germany relies entirely on her State Veterinary Service for the unique position she holds in the matter of promoting

the health and welfare of her animal population, and indirectly that of her human population also. There are numbers of private Veterinary practitioners, who are also aiding greatly in this good work, and one is at once struck with the amount of valuable material that these men supply to the College laboratories and wards and other Institutes. The liaison between them and the more official side of the profession must be very close and altogether it may be said that the Veterinary profession in Germany as a whole is a most efficient organisation and is doing a great deal towards advancing the welfare of the country. No doubt the excellent training which all German Veterinary graduates receive during their student days is largely responsible for this.

Fig. 1. A twig of an affected *ganja* plant—Enlarged

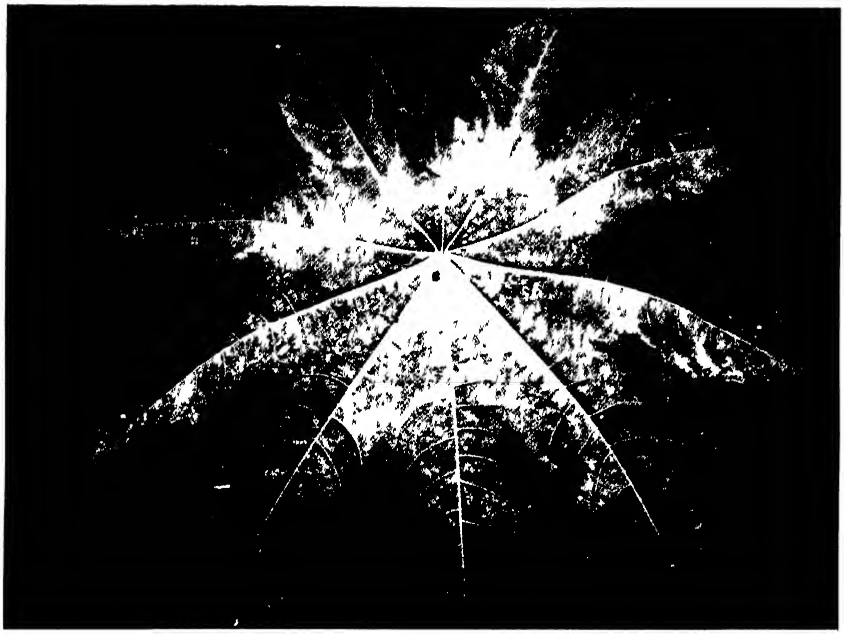

Fig. 2. Castor leaf showing attack by *Tetranychus telarius*

MITE (ACARINA) PESTS OF CROPS IN SOUTH INDIA AND METHODS FOR THEIR CONTROL

BY

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INTRODUCTION

MITES, eelworms, millipedes, crabs, snails and birds do considerable damage to crops. The paper deals with the mite pests of crops met with in South India. An attempt is made, to note the crops affected, nature of injury, extent of damage, life cycle of the pest and remedial measures.

GENERAL DESCRIPTION AND LIFE-HISTORY OF MITES

Mites belong to the order Acarina of the class Arachnida which also includes ticks, scorpions, spiders, etc. These are eight legged creatures, of small size, and sucking mouth parts. Under Coimbatore conditions, their life cycle does not exceed a fortnight. Although both sexes are present, cases of parthenogenesis are not uncommon. The adults as well as larvae and nymphs feed on the plant sap as a result of which the affected portions of the plant dry up.

MITE PESTS OF CROPS

Nine species affecting different crops are treated in this paper. These are :

Tetranychus telarius. (Family—Tetranychidae).—This is a well-known mite [Hirst, 1920] ; [Cherian, 1932 ; 1934, 2], and is found on a variety of plants, the more important of which are *ganja* (*Cannabis sativa*), castor (*Ricinus communis*), tomato, (*Lycopersicum esculentum*), Cambodia cotton (*Gossypium hirsutum*), rose (*Rose* spp.) and jasmine (*Jasminum sambac*).

On *ganja* the mites do enormous damage and, in some years, about thirty to fifty per cent of the crop may be affected. They take about nine to twelve days to complete their life cycle. They puncture the leaves and flowers and feed on the sap, the affected portions drying up gradually. In case of severe infestation the attacked portions of plants are found webbed together (Plate XXXIV, Fig. I.) Cakes prepared from such plants are very poor in quality.

In the Madras Presidency, the *ganja* crop is grown only in two centres, *i.e.*, at Santaravur in Guntur district and Hosur in Salem district. The pest is found in

a fairly serious form in both these places. In one year, the crop grown in the Central Farm, Coimbatore, for experimental purposes, had to be destroyed due to the attack of this mite.

The application of sulphur is generally effective against all kinds of mites. But, in the case of *ganja*, some other remedy had to be found out because it was noticed that cakes prepared from plants dusted with flowers of sulphur or sprayed with lime sulphur contained traces of sulphur which produced irritation when smoked. Fish oil rosin soap at a strength of one lb. in six gallons of water was found effective against the pest and cakes prepared from plants which received this treatment passed the smokers' test successfully.

The same mite is also found on castor. The plants may be affected during early period but more during late period. In serious cases of infestation, both the leaves and fruits are affected. The attacked leaves (Plate XXXIV, Fig. 2) can easily be spotted out by the presence of pale white spots on their upper surface.

Cambodia cotton is yet another host plant of the mite. Uppam (*Gossypium herbaceum*) and Karunganni (*G. indicum*) have not been noticed to be infested by the above mite but they are subject to the attacks of a mite belonging to another family—Eriophyidae, details of which will be mentioned later.

Rose and jasmine plants are also found to suffer at the hands of *Tetranychus telarius*. In cases of severe infestation all the leaves dry up and wither, thus affecting the production of flowers.

Tetranychus fici Hirst (Family—Tetranychidae).—These mites [Hirst, 1926]; [Cherian, 1931] have been collected from figs (*Ficus carica*) and are known to feed on the leaves and fruits. In South India these have been reported from Coimbatore and Hyderabad. In the latter place the pest is stated to "cause damage of a severe type preventing ripening of the fruits". It has also been collected on the same host plant at Pusa.

Tetranychus bioculatus. Wood-Mason (Family—Tetranychidae).—The pest [Fletcher, 1914]; [Cherian, 1931] has been reported doing serious damage to the leaves of the tea plant in the Nilgiris. It is generally found on the upper surface of the leaves and is mostly injurious during spells of dry weather. Dusting flowers of sulphur (one cwt. per acre has given good results).

Tetranychus hindustanicus Hirst (Family—Tetranychidae).—This mite [Cherian, 1931] which is found on citrus varieties is greenish yellow in colour and produces small circular pale white patches on the leaves. The same mite has been noticed in fairly large numbers on Persian *neem* (*Melia azadirachta*) and margosa (*Azadirachta indica*).

Tetranychus sp.—A species of Tetranychus doing considerable damage to *Hibiscus esculentus* (Ladies' finger) has been collected from the Central Farm orchard, Coimbatore. This appears to be a new species. The mites are found in very large numbers on the under surface of leaves and the plants suffer badly due

Paratetranychus indicus Hirst

(Sorghum mite) and its natural enemies

1 Sorghum leaf showing mite attack
2 Mite attacked portion of leaf enlarged
3 Eggs of the mite
4 An egg enlarged
5 Nymph
6 Female
7 Male
8 *Scymnus gracilis Motsch*
9 *Scolothrips sexmaculata Pergande*
10 *Olygota flaviceps grub*
11 *O. flaviceps Bernh* adult

to their attack. Spraying of lime sulphur (one in forty) has given fairly satisfactory results. The mite has been reported to attack the same host plant in Cochin.

Paratetranychus indicus Hirst (Family—Tetranychidae).—The bright red colour which is found on the leaves of the *cholam* (Sorghum) plant is the outcome of attack of this mite [Hirst, 1923] ; [Cherian, 1933 ; 1934, 1] (Plate XXXV). A large number of eggs, larvae, nymphs and adults of this mite are found on the lower surface of affected leaves. The reddish colour of the leaves is the first visible symptom. The affected leaves dry up in a few days' time. The whole life cycle of the pest lasts from nine to twelve days, the egg, larval and nymphal periods being three to four, two to four and four days respectively.

The mites are found in most of the tracts where sorghum is grown. In the Central Farm, Coimbatore, the amount of loss has been roughly estimated at 5 per cent. The loss seems to depend on the age of the plants affected. If tender plants are attacked these may not produce any earheads at all while if the mites attack only during later period of the growth of the crop the earheads are not much affected.

Dusting of flowers of sulphur has given satisfactory results but it may not be economical to use this on a crop like *cholam*. The plants attacked first may be pulled out and destroyed so that the mites may not spread to other plants.

The same species has been noted on sugarcane for the first time in Coimbatore. The symptoms of damage are the same as on sorghum.

Paratetranychus punicae Hirst (Family—Tetranychidae).—The two host plants of the mite [Hirst, 1926] ; [Cherian, 1931] are pomegranate (*Punica granatum*) and grapevine (*Vitis vinifera*). These mites are greatly in evidence during certain seasons of the year, especially when tender leaves appear on the plants. If not checked in time, most of the leaves dry up and the yield of the plants get reduced considerably.

Various other species of Tetranychidae collected include *Paratetranychus oryzae* on paddy, *Raoiella indica* and *Tetranychus fijiensis* on coconut leaves and *Amenosius* sp. on coconut flowers. These are, however, found only occasionally.

Eriophyes carinatus Green (Family—Eriophyidae).—This mite [Fletcher, 1914] known popularly as " the purple mite of tea " is very small in size, measuring about one-fifth of a millimetre and with only two pairs of legs. It is found sometimes as a serious pest feeding on both sides of the leaf. The adult mite can be distinguished by the five ridges of waxy material found along the dorsum.

Eriophyes gossypiella (Family—Eriophyidae).—This is known as the Cottony Woolly Mite. It attacks Uppam (*Gossypium herbaceum*) and Karunganni (*G. indicum*) in Coimbatore and also in other parts of the Presidency where country cottons are grown. The affected leaves can be distinguished by the patches of

whitish hairs found on them. The attack is generally noticed late in the season. The mite has been reported as a pest of cotton in Bombay [Jhaveri, 1921].

Natural enemies of mites

Of the various natural enemies of mites studied at Coimbatore, *Scymnus gracilis* (Family—Coccinellidae) (Plate XXXV, fig. 8), *Scolothrips sexmaculatus* (Family—Thrpidae) (Plate XXXV, fig. 9) and *Oligota flaviceps* (Family—Staphylinidae) (Plate XXXV, figs. 10 and 11) are the more important ones but these are not found in large numbers as to check the pest.

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THE INFLUENCE OF SKELETAL ALTERATIONS ON THE MILCH QUALITIES OF THE SAHIWAL BREED

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THE Sahiwal breed of cattle has been recognised for a long time as one of the best, if not the best, milch breeds in India. It has capacity, great scope, a high butterfat content linked with a first class digestive system and an excellent milch temperament, all of which points contribute to its present position as a leading milch breed in India. Work on breeding and selection of this valuable milch breed has been in progress for a considerable period at Pusa and is now being continued at New Delhi, and this article deals with a line of work which has arisen in course of our selection work on milk.

The ideal points of the breed have been enunciated in the first of my articles on Feeding and Handling Experiments on the Pusa Pedigree Sahiwal Herd [Sayer, 1934], and show clearly that in certain points, a considerable difference existed between the ideal and the breed as it then was, and is in many localities. The new standard of points drawn up by the meeting of Sahiwal breeders at the All-India Cattle Show at Delhi in February 1938 is given here.

This lays down clearly the lines to be followed in breeding for correct udder development in this breed, and the ideals to be aimed at, and all who know the breed well will agree that this is one of the most urgent and necessary reforms to be taken up by breeders. Similarly, the development of the loose sheath in bulls, especially at an early age, is also referred to, and here again breeders are made fully aware of the necessity for guarding against this defect.

SCALE OF POINTS FOR THE SAHIWAL COW

Head.—A. Medium size, lean ; face dished ; broad between eyes ; horns, if any, not exceeding three inches in length.

B. Eyes mild, full and placid ; ears medium ; muzzle broad, not coarse with wide open nostrils and muscular lips ; jaw strong.

Neck.—Lean, rather long with clean throat, neatly joined to head and shoulders.

Body.—A. Shoulders light; good distance through from point to point, but thin at withers; chest deep and full between and just back of forelegs.

B. Ribs amply sprung and wide apart, giving wedge shape, with deep large abdomen, firmly held up, with strong muscular development.

C. Back straight and strong with prominent spinal processes; loins broad and strong.

D. Rump long to tail setting and level from hip bones to rump bones.

E. Hip bones high and wide apart.

F. Thighs wide apart and flat, giving ample room for udder.

G. Legs proportionate to size and of fine quality, well apart, with good feet, and not to weave or cross in walking.

H. Hide loose and mellow.

I. Tail thin, very long, with good switch, not coarse at setting on.

Mammary development

Udder.—A. Large size, flexible, and not fleshy.

B. Broad, level or spherical, not deeply cut between teats.

C. Fore udder full and well-rounded, running well forward of front teats.

D. Rear udder well-rounded, and well out and up behind.

Teats.—Of good and uniform length and size, regularly and squarely placed.

Milk veins.—Large, long, tortuous and elastic, entering large and numerous orifices.

Size and general appearance

Size.—Mature cows 800 to 1,100 pounds.

General Appearance.—A symmetrical balancing of all the parts, and a proportion of parts to one another, depending on size of animal with the general appearance of a high class animal, with capacity for feed and productiveness at pail.

Colours.—Red (self), red and white, fawn, fawn and white, mulberry fawn, mulberry fawn and white.

Scale of points for Sahiwal bulls

1. *Head.*—Masculine, face broad, forehead massive.
2. *Horns.*—Short, broad.
3. *Eye.*—Full, upper lid heavy but not exaggerated.
4. *Dewlap.*—Fine, ample.

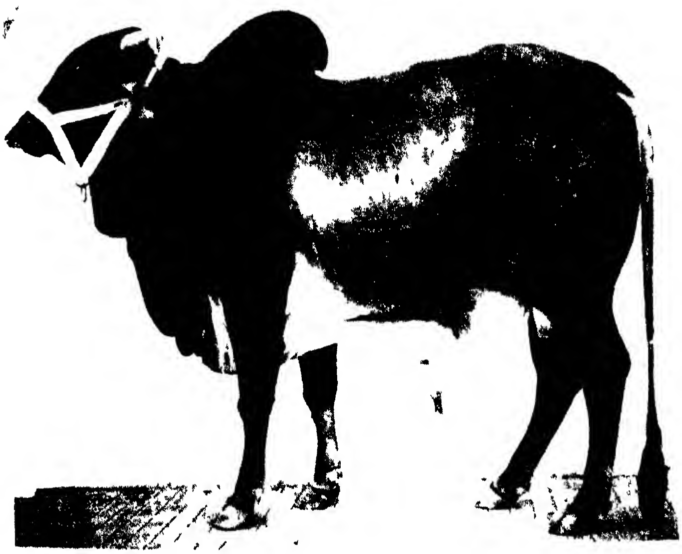

FIG. 1. Showing a very pendulous sheath in a typical young Sahiwal bull

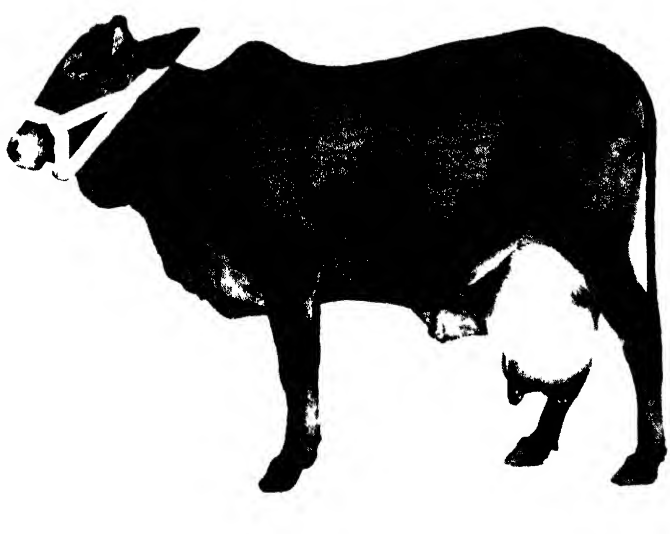

FIG. 2 Showing goose rump, loose skin and pendulous udder in a Sahiwal cow of the original foundation line

5. *Neck.*—Long, strong, well set.

6. *Chest.*—Broad, deep, well developed.

7. *Back.*—Long, straight, level along tail head and long from hook to pin.

8. *Barrel.*—Deep, well sprung.

9. *Hindquarters.*—Light.

10. *Hump.*—Well developed, upright and proportional.

11. *Tail.*—Long, well set, fine and tapering to switch, with switch black preferable, coming well below hocks and not coarse at setting.

12. *Body.*—Broad across hook and pin bones, deep through heart.

13. *Skin.*—Fine, loose.

14. *Sheath.*—Not to be abnormally loose or long (in young bulls especially).

15. *Colour.*—Same as females but darkening towards head.

16. *Weight.*—1,000 lbs. to not less than 1,300 lbs. at full mouth. (All bulls should be shown in service condition. Hind feet and hocks to be examined for this).

In order to make matters perfectly clear, the author gives here two photographs : (*i*) a typical Sahiwal bull—old type (plate XXXVI, fig. 1) and (*ii*) a typical high-yielding cow of our original foundation line (Plate XXXVI, fig. 2). A detailed study of these photographs will enable close students of these problems to follow the line of work which he is endeavouring to elucidate in this article.

Examining the bull first—it will be seen that he is short in the couplings, has a goose rump and a tremendous amount of skin round the sheath Now to the best of author's knowledge, these have been from earliest times recognised Sahiwal points which have always appeared in the breed and have also been considered to be closely linked up with high milch production, and as such to be entitled to all respect in a milch breed.

The cow also shows the same points : loose skin, short couplings, goose rump, but in her case it is particularly marked, as the udder is very pendulous and contracted both front and back, being in fact pear shaped, while the teats are bottle shaped and very large. These again are apparently typical Sahiwal breed points, except that the normal udder in a moderate producer is not such an enormous vessel. This cow, however, is a high producer, having yielded between nine and ten thousand pounds in 300 days.

Points such as have been enumerated above are perfectly possible on and in a breed where normal yield is a small one, and where the usual period of service of the bull is for a few years only in his prime. Hence they appear to have existed undisturbed in the past and have been handed down as part of the milch qualities of the breed.

Directly work at Pusa was started on breed improvement lines, as opposed to plain breeding, *i.e.*, selecting up the cows for high yield and linking up high yield factors with breed points, proving selected bulls, noting their breed characteristics and using them over the herd after they had been proved, it became [1] too evident that we were up against several marked difficulties, besides the ever present one of milk yield, and that it would be necessary to view the breed not so much in the light of a good milch breed from Indian standards, but to take a far longer view and visualise the Sahiwal as one of the best milch breeds of the world, which was what we were prepared to aim at.

The author may here state that it is his considered opinion after twenty-four years of work that in the Sahiwal breed we own the essential parts of one of the world's best milch breeds, and we have the most important qualities already present. It merely remains to make certain outside structural alterations to bring the breed in line with the world's best.

All milch breeds have been improved in the same way, bulls have been used, proved, and if found to be improvers used back again on the herd, and this has been the practice all over the world, and it is quite clear that no departure from this system is possible or desirable in India.

The first difficulty about the Sahiwal male stock was that they became sluggish at an early age and to a great extent impotent in later life. They developed late and went off early, and it was usually found that by the time daughters came in milk, their sires were useless for service. This was practically accepted as a general characteristic of the breed and regarded as a necessary evil. It is no exaggeration to say that at Pusa a considerable percentage of the bulls were practically impotent after nine years of age, and this was almost always the case with bulls carrying the long loose sheath associated with high milk production. Whenever a bull with a tight light sheath headed the herd, he was able to continue service, but as such sheaths were disliked and said to be inimical to high milch production, it was not often that such bulls were used. With the new policy of proving bulls and then using them over the herd, it soon became evident that if the breed was ever to reach the front rank in milch production, it would be necessary to reduce the sheath in order to enable proved bulls to be used for service over the herd and remain in service to an old age.

With this in view, work was commenced on the so-called relationship between the original loose sheath and high milch production. Bulls with much tighter sheaths are frequently bred from the best stock, and one such bull was kept and proved (Plate XXXVII). His stock tested out quite up to standard in milch qualities, and the females in most cases carried and transmitted the factor for tighter lighter sheaths. A son of this bull (Plate XXXVIII, Fig. 1) was then put into service, and his stock in many cases showed a very distinct diminution of sheath, markedly so as regards the umbilicus in the females, while their milch

Sahiwal bull with a tighter lighter sheath

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Sahiwal bull with a tighter lighter sheath

Fig. 1. Showing the absence of sheath in a Sahiwal bull bred from the bull shown in Plate XXXVII

Fig. 2. Showing the absence of loose skin in a Sahiwal cow

Fig. 1. Showing the presence of loose sheath in a bull calf

Fig. 2. Showing the absence of loose skin in a cow calf

FIG. 1 Showing the absence of loose skin in a cow calf

FIG. 2 Lakhram (on left) and Nalcham Comparison between two heifers one having a very pronounced umbilicus and the typical udder and the other hardly any umbilicus and a very flat udder

qualities appeared unimpaired. We have now obtained quite definite evidence for three generations that a tight sheath does not inhibit milk, and in future a loose sheath in bulls can be regarded as a definite defect from the service if not the milch point of view. In short, there was no necessity for a loose sheath as was believed in the past.

In the female stock, it has already been noted that the loose fold of skin in front of the udder, if of considerable extent, was always accompanied by a dropped rump and a pendulous pear-shaped udder hung in the middle and carrying very pronounced bottle teats. This udder, while a thoroughly bad vessel to handle and deal with in a moderate milking cow, represents a very definite bar to the breed ever entering the highest class of milch producers. Not only was the udder a shocking shape, but it was hung on such a short line that any improvement forward was out of the question, while the complete absence of any carry up the back had resulted in a weaving walk being common in the breed. This peculiar shape of the udder and its middle hanging is directly traceable to the dropped rump, for the udder is hung on the skeletal line " hook to pin ", and its spread forward and back is directly represented by the angle on which it is hung. In short, once straighten the top line, and a level hung udder extending out forward and well up behind capable of the biggest yields and proper handling was at once possible.

It was, therefore, necessary to find a bull who would straighten the top line and so enable the udder to be improved. For a long time, the author was of opinion that it would be necessary to experiment widely with outside blood as has been the case with most other breeds, but thanks to our exceptional records and knowledge of the ancestry of our main lines, our internal line breeding has proved successful, and the results can be seen in the enclosed photographs (Plates XXXVIII, Fig. 2 to Plate XL, Fig. 1). The comparison between the two newly calved heifers " Lakhram " and " Nalcham " (Plate XL, Fig. 2) is most noticeable. They are milking equally, but in subsequent lactations there can already be little doubt as to which will be the easier cow to keep in milch form. As the author writes this, both have given about 3,000 lbs. in 100 days and while Nal cham's bag is improving, Lakhram is already developing bottle teats to a marked degree. The photograph of Chirengee (Plate XXXVIII, Fig. 2) in her third lactation shows the extent to which the loose skin can be reduced, while the three photographs (Plate XXXIX and Plate XL, Fig. 1) of calves make it quite clear that the sheath and umbilicus are both points which can be bred out or in as the breeder wishes.

Lines of work in this direction are called for in many breeds, as it is quite impossible to maintain characteristics, however unique, which militate against definite utility in a milch breed in these days of close competition and careful financial consideration of all aspects connected with India's milk production.

Cross-breeding only succeeded in India, because the indigenous breeds at that time were quite unable to compete ; yet these indigenous breeds possessed the milk as is clearly seen now, but they were hopelessly handicapped by religious prejudices, lucky marks and a total ignorance of the principles of selection. These have now been to a great extent overcome, but the necessity of investigating to the full, the supposed linkage of all such fancy points with utility qualities is still one of the most important lines of work facing the real cattle breeder in India, and the quicker it is undertaken, the sooner the results will be able to make their influence felt on a lot of the uncontrolled work now in progress.

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CAN WATER HYACINTH BE USED AS A CATTLE FEED?

BY

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THE water-hyacinth (*Eichornia crassipes*) is now well known all over India. In Bengal it is called *Kachuri*, *Tagoi*, *Belati páná* or *German páná*., and the wide interest taken both by people and Government for its eradication is an evidence of the concern with which it is looked upon in the Presidency.

Starting apparently as an ornamental plant it now infests every small and big water way and in some places it forms such a dense mass that it makes navigation impossible. Maitra [1926] and Bose [1933] state that its introduction at Narayangunj in east Bengal was by Mr. George Morgan. Whoever might have introduced it there it spread rapidly and is now a menace all over the province. When Lord Carmichael was the Governor of Bengal, the Narayangunj Chamber of Commerce brought the matter to his notice (about 1914) and it was at the instance of His Excellency that an investigation was taken up; and as preliminary measure the aspects of its chemical constituents formed the earlier subject of study. It was found that the chief characteristic of the plant was a high potash-content which was as much as sixty per cent KCl on ash. Both in the form of ash or in rotted condition it provided an excellent material as a fertilizer or manure.

A short investigation of its utilization as a cattle food was taken up about 1923-24 but this was of a casual nature. More recently when the Animal Nutrition Section was started in Bengal under the grant of the Imperial Council of Agricultural Research, the digestion and metabolic tests were conducted. The work was chiefly prompted by the fact that in some parts of eastern districts when rains and flood submerge a large tract of the land, cattle can be seen wading through these areas to munch and eat the only available green plant which spread its floating verdure over a large expanse. In fact in some districts such as Tipperah and parts of Dacca, the people even purchase the plant for feeding their cattle. It has come to the notice of the authors that buffaloes have been found feeding on it in some parts of twenty-four Parganas. The investigation on its feeding value was therefore necessary from the standpoint of its effect on the animals.

The analysis shows that water-hyacinth contains a large amount of water (about eighty to ninety-five per cent). Its nitrogen content is comparable with other green fodders (0·97 per cent to 2·57 on dry weight). It is exceptionally rich in potash (about 5 per cent on dry weight) and chlorine (three to four per cent on dry weight). In lime (3·5 per cent) and magnesia (0·96 per cent), it is found to be richer than Napier and Guinea grass. Its phosphate content is somewhat low (0·36 per cent). The only point which probably militates against its utility as a regular fodder is its very large potash and chlorine contents.

The experimental scheme was drawn up having regard to the following. The slender resources of the cultivator do not permit a reasonable or liberal use of concentrate. On the other hand it has been found that green fodders can in many cases serve this need to a great extent. If hyacinth could provide some of these features it would be able to fill up a great want. The experiment therefore included the following :—

1. *Aman* straw in combination with hyacinth (No cake).
2. *Aman* straw in combination with hyacinth supplemented with linseed cake.

The experiments were conducted at two places, Dacca and Rungpur. In each place two animals were put under each set of combinations. They were first accustomed to their feed and when they had sufficiently settled down, digestion and metabolic tests were conducted.

'In the case of hyacinth (No cake) group the feeding lasted for about four months at both the places. The feeding with cake lasted for a longer period, *viz.*, for six months at Dacca and virtually a year at Rungpur. The Rungpur feeding enabled one to see whether a continuous feeding was followed by any deleterious effect.'

In order to persuade the animals to eat hyacinth the following procedure had to be adopted. The animals were given straw only in the morning and hyacinth only in the afternoon. The quantity of straw was also partially restricted in order that the animals might be impelled to take to hyacinth eating. The Rungpur animals never took kindly to it and their hankering for straw was so great that they would devour whatever straw was given and would leave the trough as if it was wiped clean.

The first difficulty was to accustom the animals to eat the material. They were never used to hyacinth feeding before, and the attempt to feed them with this stuff produced different results depending on the place, season and to some extent on individual likes and dislikes. Thus during the first set of experiments with "No cake" group the animals at both the places began to eat the material within a shorter period. The feeding had commenced about 11th to 26th April and continued up to 14th to 25th August. But in the case of feeding with cake the animals took a long period and even then they were not inclined to take larger quantities.

The feeding had commenced from early November and lasted till the end of April at Dacca while it continued up to the end of October at Rungpur. At Dacca the animals began taking small quantities from the commencement but the amount was very small (200 to 500 grms. green material) for the first five or six weeks. At Rungpur the dislike was still great. Animal R_5 did not touch it for the first three weeks while R_6 continued its dislike for full seven weeks. It would thus seem that Rungpur material was less palatable. But when the feeding was conducted with " Cake " the animals behaved much better in so far as the hyacinth consumption was concerned.

In the case of hyacinth "No cake" group one of the animals (R_7) did not seem to tolerate the hyacinth well. Outwardly there was no marked manifestation of weakness. But it would often exhibit a lassitude, would lie down and would not be much inclined to get up. Its another characteristic was that it preferred stems to leaves while its companion R_8 would eat leaves generally. It was also sick for some time. On the termination of hyacinth feeding after four months it was returned to farm ration and grazing, but partly due to over-eating and partly to poor condition of health it succumbed within a few days. The cases of other animals under " No cake " group were not generally satisfactory. All lost severely in weight. When the feeding was supplemented with linseed-cake the condition was much better. These are set up in the following :—

TABLE I

Feed	Animal No.	Duration of feeding	Live-weight At start	Live-weight At the end	Live-weight Loss or gain
		Weeks	lb.	lb.	lb.
Aman straw Hyacinth and No cake	D_1	17	404·8	338·8	−66·0
	D_2	17	418·0	366·6	−51·4
	R_7	17	476·0	444·1	−31·9
	R_8	17	485·0	437·0	−28·0
Aman straw Hyacinth and Linseed-cake 1 lb. . .	D_4	21*	433·3	435·7	+2·5
	D_5	21	425·5	442·2	+16·7
	R_5	41	367·0	360·0	−7·0†
	R_6	41	354·0	371·0	+17·0

*From the stage when the animals settled down to their feed.

†This animal lost during the last two weeks before which it was about 372 lbs.

In the case of the "Cake group" considerable time elapsed before they settled down to a condition of equilibrium. Their initial weights were higher, but due to their disinclination to eat hyacinth the consumption of dry matter was low and they went down in weight until they came to a more or less stationary condition. The earlier weights are hardly relevant and the results in Table I have been represented from the stage of equilibrium.

It has been already stated that the animals were never before under hyacinth-feeding. Possibly if they had been selected from those who were under a habitual necessity of getting their fill from hyacinth, the results might have been better and more pertinent to the point. As it is they have to be taken with some qualification. We note that when hyacinth is fed with straw only there is a steady loss in live-weight, and so it is not sufficient for maintenance. When however it is supplemented with cake, the condition is much better and a slight gain is noticeable. This beneficial effect of cake is reflected in a better consumption of total dry matter and correspondingly better availability of total digestible nutrients and starch equivalent. These are set up in Table II.

TABLE II

Computed on 500-lbs. live-weight

Feed	Animal No.	Total dry matter consumed	Total digestible nutrients	Starch equivalent	When "No cake" group is 100: Total dry matter	Total digestible nutrients	Starch equivalent	Nutritive ratio 1 :
		lb.	lb.	lb.				
"No cake" group (Hyacinth)	D_1	8·886	3·735	2·667	..	..	..	85
	D_2	9·212	4·424	3·319	..	..	..	90
	D_1	9·169	3·206	2·396	..	..	..	Negative
	D_2	8·709	3·812	2·697	..	..	..	,,
	R_7	9·662	4·423	3·458	..	..	..	21
	R_8	8·876	4·082	3·175	..	..	..	21
Mean .		9·086	3·947	2·952	100·00	100·00	100·00	
"Cake" group (Hyacinth)	D_4	12·234	6·261	5·216	134·65	158·63	176·694	11
	D_5	12·179	6·484	5·446	134·04	164·28	184·485	9
	D_4	11·650	5·508	4·465	128·22	139·55	151·253	10
	D_5	11·811	5·581	4·526	129·99	141·40	153·320	10
	D_4	10·223	5·837	4·837	112·51	147·89	163·889	6
	D_5	10·435	5·535	4·522	114·85	140·23	153·184	6
	R_5	9·243	4·919	4·013	101·73	124·63	135·942	9
	R_6	10·686	5·378	4·796	117·61	136·26	162·466	10
Mean .		11·058	5·688	4·728	121·70	144·11	160·154	

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TABLE II

Computed on 500-lbs. live-weight

Feed	Animal No.	Total dry matter consumed	Total digestible nutrients	Starch equivalent	When "No cake" group is 100: Total dry matter	When "No cake" group is 100: Total digestible nutrients	When "No cake" group is 100: Starch equivalent	Nutritive ratio 1 :
		lb.	lb.	lb.				
"No cake" group (Hyacinth)	D_1	8·886	3·735	2·667	..	..	..	85
	D_2	9·212	4·424	3·319	..	..	..	90
	D_1	9·169	3·206	2·396	..	..	..	Negative
	D_2	8·709	3·812	2·697	..	..	..	"
	R_7	9·662	4·423	3·458	..	..	..	21
	R_8	8·876	4·082	3·175	..	..	..	21
Mean .		9·086	3·947	2·952	100·00	100·00	100·00	
"Cake" group (Hyacinth)	D_4	12·234	6·261	5·216	134·65	158·63	176·694	11
	D_5	12·179	6·484	5·446	134·04	164·28	184·485	9
	D_4	11·650	5·508	4·465	128·22	139·55	151·253	10
	D_5	11·811	5·581	4·526	129·99	141·40	153·320	10
	D_4	10·223	5·837	4·837	112·51	147·89	163·889	6
	D_5	10·435	5·535	4·522	114·85	140·23	153·184	6
	R_5	9·243	4·919	4·013	101·73	124·63	135·942	9
	R_6	10·686	5·378	4·796	117·61	136·26	162·466	10
Mean .		11·058	5·688	4·728	121·70	144·11	160·154	

To facilitate comparison the data have been calculated on 1000 lb. live-weight and if the mean of "No cake" group is taken as 100 the corresponding values in "Cake" group has given an increase of 21·7 per cent in dry matter, 44·11 per cent in total digestible nutrients and 60·15 per cent in starch equivalent on the basis of mean, whereas in individual cases it has been much more in some as can be seen from Table II.

In order to judge the value properly it is necessary to get an idea of the nutritive values per 100 lbs. of the material. These are set up as follows :—

TABLE III

Digestible nutrients, etc., per 100 lbs. (Dry basis)

Feeds	Total digestible nutrients	Starch equivalent	When "No cake" group is 100	
			Total digestible nutrients	Starch equivalent
	lb.	lb.		
Hyacinth (No cake group) .	41·340	34·247	100·00	100·00
Hyacinth (Cake group) . .	55·326	49·484	133·832	144·491
Guinea grass . . .	53·345	40·637	129·040	177·058
Napier grass . . .	52·785	43·116	127·685	125·897
Aman straw. . . .	44·139	29·519	106·771	86·194
Aus straw	43·020	28·761	104·064	83·978
Linseed cake . . .	70·574	68·483	170·716	199·968
Mustard cake . . .	68·749	66·050	166·301	192·864

It will be noted from this that the digestible nutrients in hyacinth compare quite favourably with green fodders like Guinea grass or Napier grass and show an apparent superiority over rice straw (*Aus* or *Aman*). This superiority would have been real if the palatability of hyacinth had not come in the way. It is just possible that this lack of palatability is associated with a heavy percentage of potash and chlorine. The presence of such a heavy quantity of potash probably reacts on the general mineral metabolism also. The tests on the mineral side were limited but the few done show that the feeding involved an ingestion per 500 lbs. about 96 to 106 grms. K_2O, eighteen to twenty grms. of chlorine, forty-eight to sixty-five grms. of CaO. The potash and chlorine balances were clearly negative and though lime ingestion was high, the balance figures were fifty per cent negative

It will thus be seen that hyacinth can hardly occupy a high place as a fodder. If its value had been high popular usages would have already forestalled it on an established footing. But here we are faced with its existence more as a necessary evil; and the problem is not so much as to establish it as a fodder but to explore the avenues of its possible utilization. The experiment shows that under the singular circumstances in which the country is placed, the moderate use of hyacinth as a fodder can be permissible, but in order that full benefit is derived from it, it should always be fed in combination with cake or concentrate and still better in a combination of a number of feeds.

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NOTES FROM THE PROGRESS REPORTS OF THE RESEARCH STATIONS, 1936-37

Rice

1. *Plant Breeding.*—At Berhampur (Madras), two strains, yielding 25 per cent increase over the respective ryots' bulk, have been evolved in each of the five major varieties of the tract. Cultures have also been isolated from another set of eight varieties, the yield tests on which indicate more than 15 per cent increase.

In the Central Provinces at Raipur, breeding work was continued particularly with a view to evolve heavy-yielding strains which can be easily distinguished from wild rice. The F_3 generation of the cross E.B. 17 × Nagkesar was grown and some promising hybrids possessing the desired combination of characters have been secured, which have given higher yield than the existing good variety E.B. 17. An F_2 population of 81,759 plants was grown from the crosses of Nagkesar with Bhondu 10, Budhiabako 1, Gurmatia 17 and Luchai 4 and a study has been made of the inheritance of important economic characters. In yield trials, the hybrid strains Bhondu × Parewa Nos. 22 and 116 have proved considerably superior to the prolific strain Bhondu 10. Cross No. 19 maintained its reputation as a high-yielding fine rice which can be distinguished from wild rice. These hybrids were distributed for the first time during the year and met with considerable success. Studies on the percentage of cross pollination showed that at Raipur the percentage of natural crossing does not exceed 1·3 but can take place to a distance of ten feet.

In the United Province at Nagina, the study of the F_7 generation of the *Sathi* crosses has definitely established the immunity of the hybrids to the *gundhi* insect. From the point of view of earliness, many of these hybrids are a distinct improvement on the types now under distribution, while in yield they supersede the *Sathi* parent. Many of the hybrids bred true and some of them have reached the stage when they can be put under final yield tests. The F_7 generation of the economic crosses, although not remarkable in the matter of earliness, gave some heavy-yielding hybrids. One of these, Type 136, is already under distribution and two more of promise have been isolated. The hairiness of leaf studied in an F_2 of *Sathi* (T. 131) and a late type (T. 127) indicated the dominance of hairiness in inheritance. Studies on hybrid vigour as in the previous year showed that the phenomenon is not pronounced in paddy and as such is of little commercial value.

In Burma, two hybrid selections, Xa 97 and Xa 108 were grown on 500 acres in the Southern and Irrawaddy Circles during the year. Yields were good and the crops were reported to be satisfactory. Xa 97 appears to be the most suitable strain for the Southern Circle, while Xa 108 is preferred in the Irrawaddy Circle. If these grains mill well, they can be grown over wide areas in Lower Burma, because they give a good yield and are popular with cultivators. Studies of inheritance of size and shape of grain indicated that shortness was dominant over length of grain and that many factors were involved. As regards breadth, grains of F_2 generations showed that thinness was dominant over broadness of grain.

2. *Cultivation.*—At Berhampur (Madras), it was found that a well cultivated and well managed broadcast crop of paddy yielded as much as a transplanted crop in the canal-fed areas.

In Burma, taking all the data together for the year under report, it may be inferred that for the early maturing strains harvesting at twenty-five to thirty days after flowering combined with shade drying gives the best results in avoiding cracked grains, whereas harvesting at thirty to thirty-five days after flowering combined with shade drying is the best in the case of late strains.

At Bankura (Bengal), broadcast sowing gave significantly higher yield of straw than transplanting and in yield of grain is just on the border line of significance over transplanting with twenty-one days old seedlings. These results are not in agreement with last year's observations.

3. *Manuring.*—At Berhampur (Madras), superphosphate, Ammophos and green leaf supplied heavily to the nursery alone gave no response, whereas when applied to the transplanted plot there was increased yield irrespective of manuring in the nursery. Superphosphate (at 25 lb. P_2O_5 per acre) without a basal dressing of green leaf did not give any response, but with 4,000 lb. of leaf it gave a net profit of Rs. 4-8 per acre. Ammonium sulphate to supply 25 lb. nitrogen per acre without leaf, though yielding a little increase over no manure, is not economical at its present price (Rs. 5-10 per 100 lb.), but with 2,000 lb. of green leaf a net profit of Rs. 4 per acre was obtained. Application of slaked lime at even 1,000 lb. per acre over three years of the experiment showed no effect on yield. Green leaf from outside or green manure crops raised *in situ* to give at least 4,000 lb. of green matter are found to be very beneficial to the soils of Berhampur which are deficient in organic matter. Indigo is indicated as a good crop for green manuring, to be sown just after the harvest of paddy either as a pure crop or as a mixture with green gram (*Phaseolus mungo* var. *radiatus*).

At Raipur in the Central Provinces, application of phosphoric acid at 20 lb. per acre in the form of superphosphate is found most economical and gives the largest net profit of Rs. 4 per acre. Addition of 20 lb. of nitrogen in the form of ammonium sulphate makes no difference.

At Nagina (United Provinces), an experiment on the interaction of nitrogen and phosphoric acid indicated, as in the three previous years, that only nitrogen differences were significant, phosphoric acid being without any effect on yield and maturity. Green manuring with *sanai* appeared superior to Nicifos and almost to ammonium sulphate and all the manures definitely superior to the control. A mixture of ammonium sulphate and sodium nitrate was not found to be superior to sodium nitrate or ammonium sulphate alone. Ammonium sulphate when applied in two or three doses yielded better results than when applied in a single dose. Green manuring with whole plants did not appear to be better than when only tops were used and the sticks removed for the extraction of fibre but the fibre extracted could not pay for the labour employed in cutting the tops and stripping the sticks. Nine or seven weeks old *sanai* when ploughed in gave better yield than a five weeks old crop. Molasses is good but should not be applied just before transplanting as it seems to" burn " the seedlings.

4. *Root studies.*—In the Central Provinces, the development of the root system was found to be much better in the heavier soil *dorsa* (forty-eight per cent clay) than in the lighter soil *matasi* (twenty-five per cent clay), although the yield is generally better in *matasi* soil.

5. *Seed viability.*—In the Central Provinces, experiments on the loss of vitality in stored rice grains indicated that the seed retains its full power of germination for about twenty months after harvest (*i.e.*, upto the time of the second sowing season). It then begins to lose its vitality.

In the United Provinces, on the other hand, germination studies with new and old seed showed that from the sowing time, (*i.e.*, seven to nine months after harvest) onwards the decline in viability of seeds proceeds at the approximate rate of six per cent per month and that within two years after harvest the seed loses all its viability. The age of seed affects not only the percentage of germination but also its rapidity, older seeds taking longer to germinate.

6. *Water requirements.*—In the Central Provinces, in irrigation trials conducted with a late ripening rice variety in *dorsa* soil, standing water treatment gave significantly higher yield than no irrigation.

7. *Insect pests.*—The *gangai* disease of paddy is caused by an insect known to science as *Pachydiplosis oryzae*. It is known to exist in the eastern districts of the Central Provinces and is gradually spreading westwards. During the year under report the intensity of the attack varied in different fields in the Central Provinces though they were quite near each other and sown with the same variety of seed. The percentage of attack varied on different varieties of paddy. The Luchai variety of paddy suffered the most and then came in order Gurmatis, Ludka and others. *Kodon* (*Paspalum scrobiculatum*) which is extensively grown in the Chhattisgarh district of the Central Provinces was also damaged to a large extent

by a similar insect. The insect from *Kodon* galls remarkably resemble *Pachydiplosis oryzae* but this requires confirmation. The variety of *Kodon* which produces white galls is more liable to attack than the one producing pink galls and it was observed that wherever the former variety was grown near paddy fields paddy suffered less. Similar galls were found on the grass *Dub* (*Cynodon dactylon*) throughout the year. Cecidomyiad flies reared out of them resembled *Pachydiplosis oryzae*. Subject to confirmation of their identity by a competent authority, *Dub* is regarded as the alternative food plant of *Pachydiplosis oryzae*.

In Assam, the incidence of humid conditions favours the increase of borers, a condition probably uncongenial for *Hispa*.

8. *Structural and chemical composition of rice grain*.—(Work at Bangalore and Coimbatore).—Studies on two starchy and two glutinous pure strains and a wild rice (*Oryza latifolia*) indicated that, in starchy rices, starch formation is confined to the pericarp layers for about ten days after fertilization and that it can be detected in endosperm cavity after four days. Until seven days after fertilisation no starch appears in the embryo, but after this period it begins to increase, up to twenty days, when it again largely disappears, the mature embryo showing only traces. In the wild rice, starch appears in the endosperm six days after fertilization and disappears completely from the embryo a fortnight after fertilization. In the glutinous rices starch is first deposited in an insoluble form in the ovary wall and appears in the endosperm cavity on the fifth day after fertilization, where it is converted into soluble form.

Formation of protein was studied from the third day after fertilization up to the maturity of the grain. Fresh specimen were found to be more suitable for study and the two reagents, Millon's and Adamkiewicz's were the most satisfactory to detect the presence of proteins out of a large number tried. The deep red staining of the first two or three peripheral layers of the endosperm up to the seventh day indicate the presence of amino-acid *tyrosine*, while the light-red reaction in the aleurone layers after this period shows the presence of the amino-acid, *tryptophane*. The deeper staining of parboiled rices indicates that in such rices proteins get diffused into deeper layers of the endosperm than in raw rices.

The innermost cells of the inner integument is the seat of colouring matter in rice. The coloured layers develop in different ways in different rices. In the case of white rices, this layer is completely disorganised by the time the grain reaches maturity. In red and light-red rices the colouring matter fills up the cells completely whereas in gray -brown and ' gold ' rices it appears in globules. In a dark-purple rice, the colour spreads to the whole of the pericarp. It has been observed that coloured and coarse varieties of rice contain larger amounts of protein and mineral matter than the fine ones. They also possess very much thicker bran layers and, even on milling the extent of loss of nutritive constituents from such

varieties which are considered to be inferior is less than the superior varieties under ordinary conditions. Coloured and coarse varieties in an unpolished condition can compare favourably with wheat in nutrition. Therefore keeping quality of unpolished rice is essentially due to the rice oil.

As regards the development of aleurone layers, it was observed that on the ventral side of the embryo the aleurone grains are generally single-layered, while those on the dorsal side are two to three celled and the individual cells on this side are thicker than those on the other side. The thickness of the aleurone layer varies in different varieties and manuring, especially green manuring tends to increase the thickness considerably. (R. L. S.)

THE LIME AND PHOSPHORUS REQUIREMENT OF BENGAL CATTLE

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The place of minerals in the economy of nutrition has assumed special importance of late. It is now well known that the difference in the feeding values of various pastures is very closely associated with their lime and phosphorus content. The work in Bengal with *aman* or winter rice straw and *aus* or autumn rice straw shows that from the standpoint of energy supply there is no marked difference in protein, lime and phosphorus. But it has been noticed that even in instances where the protein content is approximately similar the animals under *aus* straw feeding have invariably fared better than with *aman* straw.

In fact even in cases where *aman* straw was fed with a higher dose of concentrate (cake one lb.) and *aus* straw with a lower dose (half lb.) the results under the latter were much better. The evidences so far appear to suggest that this is mainly due to the better availability of minerals from it. An attempt was therefore made to study the requirement of minerals under the condition of feeding as prevailing in Bengal which may be said to be typical of North-East India. A comprehensive treatise on the subject by Carbery, Chatterjee and Talapatra [1937] has been published in the *Indian Journal of Veterinary Science and Animal Husbandry*. In the present paper the aspects of lime and phosphate requirements only will be briefly dealt with.

Lime requirement.—The experiments in this case covered twenty-four individual tests in five combinations in which *aman* and *aus* straws were fed as individual feeds as well as in combination with linseed cake or rice *kura* (bran). The investigation represented conditions in which the lime ingestion proceeded from the stage of deficiency to that of adequacy thus suggesting the lowest limit

compatible with positive retention. In Table I the intakes with the positive or negative symbols as found are set up :—

TABLE I

The intake of lime (computed on 500-lb. live-weight)

(Symbols + or — indicate positive or negative balance)

Experiment	A *Aman* straw only	B *Aman* straw + rice *kura*	C *Aman* straw + one lb. linseed cake	D *Aus* straw only	E *Aus* straw + half lb. and ¾ lb. linseed cake
Animal . .	D_3, D_7 grm.	D_2, D_6, D_7, D_3, D_4, D_9, D_8, D_1, D_5	D_3, D_7, D_4, D_1.	D_7, D_3, D_1	D_2, D_2, D_6 D_4, D_8, D_5
Intake of lime CaO in grms. .	13·475	14·270—	19·994—	20·804+	23·687+
	14·707—	15·282—	21·123+	22·925—	26·003+
	..	15·394—	21·298—	23·234—	26·095+
	..	16·090—	21·302+	..	28·395+
	..	16·231—	..	..	29·539+
	..	16·795—	..	..	31·016+
	..	17·458—	..	..	..
	..	18·024+	..	..	..
	..	18·227—	..	..	..

This table is highly suggestive. In experiment A up to 14·707 grms. intake of CaO are all negative, in experiment B (fifteen to eighteen grms. intake) eight out of nine gave negative balance, in experiment C (nineteen to twenty-one grms. intake) two out of four were negative, in experiment D (twenty-one to twenty-three grms. intake) two out of three are negative. In other words up to the stage of twenty-three grms. ingestion the general tendency has been definitely towards a negative balance. It is only when the ingestion reached about twenty-four grms. and upwards (experiment E) that a definite positive balance was maintained. The results lead to a reasonable assumption that under the condition of rice straw feeding the minimum lime requirement is about twenty-four grms. CaO per 500 lbs. or forty-eight grms. per 1000-lbs. live-weight.

Phosphate requirement.—The aspect of phosphate requirement was also studied mainly on the basis of some experiments. In this case the intakes did not follow the serial order of progressive rise as has been the case with lime; but

otherwise the conditions were more or less similar. The results divide under following :—

(1) those coming under definite deficiency,

(2) those providing adequacy, and

(3) those deviating from the normal behaviour.

Of these, items (1) and (2) are more relevant to the case in point and these are set up in Table II, while item (3) has formed the subject matter of another paper.

TABLE II

Intake of P_2O_5. (Computed on 500-lb. live-weight)

(Symbols + or — indicate positive or negative balance)

Experiment	*Aman* straw only	*Aus* straw only	*Aus* straw + half and ¾ lb. linseed cake	*Aman* straw + one lb. linseed cake
Animal . . .	D_8 and D_9	D_7, D_3 and D_1.	D_9, D_2, D_8, D_6, D_4 and D_5.	D_3, D_4, D_1 and D_7.
Intake of P_2O_5 in grms. .	4·670— 5·098—	5·727— 6·312— 6·391—	9·631— 10·728+ 12·313+ 12·376+ 12·995+ 14·319+	12·908+ 13·890+ 14·041+ 14·278+

The computation of the values on a fixed live-weight (of 500 lbs.) enables a better interpretation.

If the intakes in Table II are followed it will be noted that the first minimum intake coincident with positive balance has been in the case of animal D_2 with an ingestion of 10·728 grms. P_2O_5 (experiment E) and that all ingestions above this quantity has been attended with a definite positive balance.

It should be stated here that this experiment with *aus* straw and linseed cake represented a supply of adequate nutrients in all components. There were six animals under it, and five out of them recorded a positive balance in all nutrients (Nitrogen, CaO, MgO, K_2O, Na_2O, P_2O_5, etc.). The sixth one (animal) D_9 (shown as top one under experiment E Table II), also behaved identically in all other respects except in the case of P_2O_5 in which it recorded a negative balance. This animal along with animals D_2 and D_8 belonged to half lb. cake group and received like them about 11·2 grms. P_2O_5. But while the others recorded a definitely positive

balance, this failed to do so. On a closer scrutiny it was noticed that this animal was the heaviest of the whole lot and weighed 603 lbs. When therefore the ingestion was computed on the basis of 500-lb. live-weight it worked out at 9·631 grms. P_2O_5.

The notable feature is that no ingestion below this amount has been attended with a positive balance while all ingestions at upwards of ten grms. have been uniformly positive. This amount may therefore be taken as constituting the limiting factor for positive assimilation and we are provided with a definite suggestion that the minimum P_2O_5 requirement is about 10 grms. per 500-lb. live-weight or twenty grms. per 1,000-lbs. This amount agrees with Theiler and Green [1932] who state that "fatal aphosphorosis will develop" when the phosphorus intake drops to the vicinity of twenty grms.

We thus find that under the condition of rice straw feeding the minimum requirements are about twenty-four grms., CaO and ten grms. P_2O_5 per 500-lb. live-weight.

It remains now to be stated here that the lime requirement under rice straw feeding appears to be higher than that under other feeds. Kellner [1915] gives hundred grms. CaO per 1000 kg. as sufficient to meet all requirement. This is equivalent to 22·7 grms. CaO per 500-lb. live-weight. In India, Iyer [1935] working with Rhodes grass hay, Aurangabad hay, Spear grass hay and *Jowar* hay, found that the minimum lime requirement was about 15 grms. CaO for an animal of 750 lbs. live-weight. But in the case of rice straw [Iyer and Krishna Ayyar, 1934] it was found as in Bengal that "lime is not very readily assimilated".

It would thus appear that whatever might be the relation of minerals either with respect to the absolute amount or to their respective proportion, the nature of feed is by far the chief determining factor.

Further, although lime assimilation is generally poor from rice straw the deficiency of phosphorus in it is probably the chief limiting factor. Its feeding should therefore be supplemented with cake or material containing assimilable phosphorus, with which a small quantity of chalk may be added to make up lime deficiency.

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CAROTINOID FEEDING AND GOAT'S MILK*

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GOAT has been described as the poor man's cow, but the possibilities of its milk as a rich nutritious food has not been properly studied. The use of goat's milk for infants or children or in convalescence is considered to be superior to cow's milk and is a recognised practice in India. While the nutrition of the cow or buffalo has received considerable attention, the goat has been neglected for its milk and reared for its meat or wool only. In the course of study of vitamin A content of ghee from different breeds of animals it was observed that goat's ghee was superior to cow or buffalo's ghee [Banerjee and Sunawala, 1935]. While attempts have been made with not much of success in a number of ways by numerous workers to improve the vitamin content of cow's milk, the possibilities with other milk animals have not been tried. The physiological rôle of the animal may limit the scope of such experiments. It has been found that the carotin content of cow's blood and ghee can be increased with rich carotinóid feeding but the vitamin A content cannot be markedly improved [Banerjee and Makhijani, 1938]. The carotin content of buffalo milk or ghee is much poorer than that of cow's milk or ghee under similar conditions of feeding. The goat is a hardier animal than cow or buffalo and can subsist on leaves and shrubs. The problem of feeding goat with green tender leaves and other carotinoid material was therefore undertaken to study the effect on milk secretion and particularly the vitamin A and carotin contents of the same.

A female goat in milk with its kid was chosen for the experiments. They were kept in a fenced area of fourteen feet square and left loose for the day and were tied up separately in the evening at 5 P.M. for the night. In the morning after milking at 8 A.M. they were untied, and the kid was free to suck milk for the whole day. No milk was collected in the evening. The kid was kept for company as

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also to keep the flow of milk steady. In the first period of the experiment only tender leaves were provided as food with a supplement of about half a pound of grams per day. In the second period, to increase the carotin intake about ½ lb. of carrot were first allowed to be consumed and then the leaves were put inside the enclosure. In the third period, they were taken out in the morning and allowed to graze for the whole day on green grass and were penned up in the evening. From the middle of the second period groundnut was given as supplement in place of grams to change over from a legume protein to a nut rich in fat and protein.

The milk yield in the morning was measured during the course of the experiment. On a few days the kid got access, by accident, near its mother, and thus the milk recorded was found to be lower than usual. The quantity (green weight) of leaves consumed was measured by weighing the same before putting inside for feeding and the residues the next day. The carotin content of the leaves were determined very often by the Pyke [1936] method. The amount of faeces voided and the carotin content of the same were measured. The faeces were picked up in the morning and evening and dried. There was no risk of error as the kid's faeces were clearly distinguishable from its dam's on account of difference in size. Butter and ghee were prepared from the milk and the carotin and vitamin A were estimated colorimetrically every alternate day. An average sample of milk was analysed for its other constituents for the three periods. Samples of blood were drawn periodically to find out the carotin content in the same. The results are given in Tables I to V.

TABLE I

Carotin content of leaves used for feeding (dry weight) and faeces

Name	Carotin content in mg. per kg.	Ratio carotin/ xanthophyll
1. *Santalum album* leaf	104	1 : 2
2. *Albizzia odorotissima*	146	1 : 2
3. *Ficus infectoria*	60	1 : 2
4. *Bassia latifolia*	90	1 : 2
5. *Artocarpus integrifolia*	156	1 : 2
6. *Moringa pterigosperma*	254	1 : 2
7. *Cynodon dactylon*	213	1 : 1
8. *Daucus carota*	312	1 : 0
9. Faeces (first period)	225	1 : 2·5
10. Faeces (second period)	375	1 : 2
11. Faeces (second half)	440	1 : 1·7
12. Faeces (third period)	250	1 : 2·3

TABLE II

Composition of milk

Constituent	First period	Second period	Third period
	Percentages.		
1. Moisture	86·5	85·4	83·5
2. Total solid . . .	13·6	14·5	16·5
3. Ash	0·82	0·85	0·85
4. Lime	0·32	0·23	0·24
5. Phosphorus . . .	0·43	0·39	0·38
6. Total protein . . .	4·1	4·2	4·5
7. Lactose	3·0	3·6	4·5

TABLE III

Carotin content of blood

Date	Carotin content
12-5-1937	*Nil.*
24-5-1937	,,
5-6-1937	,,
19-6-1937	,,
11-7-1937	,,

TABLE IV

Vitamin A in ghee : Blue value in Lovibond unit per grm.

Date	Blue value	Feed
3-5-1937—15-6-1937	13·3	Leaf only *plus* gram.
17-6-1937—23-6-1937	15·4	Carrot *plus* leaves from 15th June 1937 and groundnut instead of gram
25-6-1937—30-6-1937	16·8 (A pale yellow colour appears in ghee but is not due to carotin)	Ditto.
1-7-1937—7-7-1937	22·5 (A pale yellow colour appears in ghee but is not due to carotin)	Ditto.
9-7-1937—15-7-1937	24·2 (A pale yellow colour appears in ghee but is not due to carotin)	Ditto.
18-7-1937—27-7-1937	33·0 (Colour disappears)	Grass only and groundnut

TABLE V

Milk yield and feed

Date	Milk in c.c.	Leaf consumed in pounds green weight	Faeces voided
			grms.
3-5-1937 to 17-5-1937 . .	329	8·8	600
18-5-1937 to 2-6-1937 . .	374	9·75	800
3-6-1937 to 15-6-1937 . .	498	12·9	..
16-6-1937 to 30-6-1937 . .	483	8·5	..
1-7-1937 to 15-7-1937 . .	458	7·9	600
16-7-1937 to 28-7-1937 . . .	422	..	..

DISCUSSION

The main object of this investigation was to find out qualitatively the response of carotinoid feeding on the carotin and vitamin A content of the blood

and milk of a goat. With this end in view the carotin and concentrate intake has been varied, and more than enough has always been provided. The conditions of feeding were such as could be reproduced by any owner of the animal. Roughly in nine and a half pounds of green leaves the intake of carotinoid bodies is 108 mg. and the output in 800 grms. of faeces 76 mg. In the milk-fat the secretion is about 10 mg. of vitamin A. Quarter pound of carrots provide about 7 mg. of β carotin. The normal requirement is twenty-five to thirty micro grams per kg. of body weight of the animal. For a 15 kg. weight of the animal, the requirement is only about half a milligram. The nature of the pigment whether α, β or γ in the feed is not known. The intake of carotin bodies and its conversion into vitamin A and flow in milk requires careful investigation. The absence of carotin in the blood and milk of the goat and the increase of vitamin A from thirteen Blue units to thirty-three Blue units per grm. is remarkable.

Summary

The physiology of the goat is different from that of the cow or buffalo in that it either converts carotin into vitamin A or rejects it. No carotin or xanthophyll could be detected in the blood or milk-fat even with excessive feeding. Green grass (*doob*) has a very high β carotin content and leaves a fair proportion of α and γ variety. The vitamin A content of the milk-fat of the goat can be increased to a high degree with proper carotinoid feeding. Unfortunately no carotinoid bodies can be introduced by a natural process in goat's milk, so that the storage quality of vitamin A in goat's milk-fat will be poor. With rich carotinoid feeding there is improvement in the flow and quality of milk.

Our best thanks are due to Professor V. Subrahmanyan for his keen interest in the work.

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NOTES

FLUCTUATIONS OF THE SOVIET FLAX INDUSTRY

A NOTE in the " Deutsche Leinen Industrielle " of the 14th October shows the fluctuations of the Soviet flax culture (Dolgunez), both as regards the scope of cultivation and also crop yields and export. There was a big setback in flax production between 1920 and 1924. According to Soviet statistics the pre-war area under flax was exceeded in 1925. The area went on increasing till 1932 when a considerable shrinkage in the area took place. This was partly due to the world economic crisis and partly to the far-reaching revolution in agriculture instituted by official Moscow. Crop yields also show considerable fluctuations caused in recent times. It has, however, been possible to raise yield per hectare. The flax export trade figures show a definite halt and even a reduction brought about by the development of the textile industry in Russia. From 1900 till the outbreak of the World War, Great Britain and Germany were the principal customers, each taking on the average about 50,000 tons. Since 1920 the Soviet industry has had to reckon with the competition of the Baltic States. In 1935 the export had fallen to 15,780 tons to Germany and 8,130 tons to United Kingdom while in 1936 the figures were 1,500 for Germany and 24,770 for United Kingdom.

There is a regular increase in the production of linen articles and flax yarns in Russia from 1932 onwards. (Summary of an extract from a Circular dated the 23rd October 1937, issued by the Northern Ireland Ministry of Agriculture).

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NEW PUNJAB GRAM IMMUNE TO BLIGHT

FOR many years past the gram crop in the North Punjab, particularly in parts of Attock district, has suffered from a fungal disease known as gram-blight. In years climatically favourable to the spread of this disease, the crop which has been attacked is entirely destroyed and even in years less favourable to the disease, considerable loss has occurred.

Research carried out by the Punjab Agricultural Department showed that this fungal disease is borne in the seed, but the most serious source of infection lies in diseased material from previously attacked crops. It was found that when such debris is left lying on the surface of the ground, either on old threshing floors or in fields which have been attacked by the disease, it is capable of transmitting

the infection for three years, after which it is no longer viable. If, however, the diseased material is buried in the ground by means of a furrow-turning plough, it becomes harmless after a few months. Consequently, it is possible not only to control but entirely eliminate gram-blight by :—

(*a*) Thoroughly cleaning up and burning all trash remaining on threshing floors and by burying diseased debris in old gram fields with the aid of a furrow-turning plough.

(*b*) By sowing seed free from the disease and imported from a locality where the disease does not exist.

Intensive clean-up measures of this nature were carried out for four years in Attock district and were successful in securing for the cultivator a good out-turn from his gram crop in three of these years. The fourth year, however, proved unprecedentedly favourable climatically for the spread of this disease. Fresh infection was carried in to the cleaned-up area from surrounding localities which had not been cleaned-up and the disease spread to parts of the Province where hitherto it had been unknown.

In view of the difficulty of ensuring adequate clean-up measures for the complete control of this disease, the Agricultural Department undertook an investigation of the possibilities of overcoming the disease by botanical means. It was found that all the many varieties of Punjab gram were highly susceptible to this disease. A large collection of about 180 varieties of gram was, therefore, made from outside sources. Small samples of the various grams grown, not only in other parts of India, but in other countries in the world, were obtained. All these small samples were grown at Cambellpur, which is located in the centre of the worst affected area. Of all the varieties tried, only three showed resistance to the disease. All three varieties were of French origin, but were obtained from the United States Department of Agriculture.

Continual experiments

During the past five years these three varieties have been under continual experiment and selection and, as a result a variety known at present as F. 8 has been produced, which is practically immune to gram-blight. At the Department's farm at Cambellpur during the past year on an area of 2½ acres this variety produced an average of fifteen maunds of gram per acre in a tract where all other local varieties were completely wiped out. At Lyallpur the same variety gave a yield of 18¾ maunds per acre. The Department now possess sixty maunds of this selected gram, which will be multiplied under the most favourable conditions as rapidly as possible and it is expected that in 1940 the Department will be in a position to distribute not less than 25,000 maunds of this new blight-resistant seed.

The discovery of a type of gram which is unaffected by this severe disease is an achievement of the utmost importance to cultivators in the gram growing areas in the province. There is every indication that in future they need have no more

fear of the ravages of gram-blight, which has involved them in losses of lakhs of rupees in the past. It is expected that as soon as seed is available, this new type will completely replace all local types grown at present. In colour the seeds of F. 8 are dusky yellow and in size they are larger and heavier than the usual Punjab types. Consequently, experience has shown that a seed rate of twenty-four seers per acre has to be used against sixteen seers commonly used for Punjab types.

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TESTING CONTACT POWDER INSECTICIDES

The estimation of the efficacy of contact insecticides in powder form has always been surrounded by difficulties. The trial of these or their active principles in watery solutions is not satisfactory. The powders must be tested as powders. In the journal *Anzeiger für Schadlingskunde*, 1936 No. 1 S. S. Fransen describes an apparatus for trying out the greatest possible number of powder contact insecticides in the shortest time with the fewest sources of error. This is a wooden box about one metre high and 28 c.m. in breadth with an arrangement at the upper end of two trays of fine gauze of copper or cheese cloth. The lower part of the box at one side has a small door through which the insects are introduced and a definite amount of powder is brought on the top of upper gauze and brushed through with a fine brush. The distribution of the powder on the second gauze is then practically even. By further brushing of the powder on the second tray it falls uniformally into the box below. The amount used is 300 mg. of powder which corresponds roughly to about 50 kg. of powder per hectare. If smaller quantities are used, the distribution of the powder on the gauze as well as in the box is uneven. For smaller quantities it is necessary to have still another gauze distributor above the first one. Using this method 20 mg. of powder gives useful results. If this amount is still too big, *i.e.*, if a 100 per cent of the insects die, then smaller quantities of the powder can be mixed with a neutral material such as talc. The insects under study should during the experiment be in the natural conditions, *e.g.*, on twigs. Flying insects are to be in big meshed wire cages. After testing the insects under research are to be taken out of the box in order to avoid direct contact with bottom of the box which contains considerable quantities of the insecticide. (From *Der Tropenpflanzer*, No. 4, Vol. 41, April 1938, pp. 172—173). (Translated by W. B.)

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PRIZE FOR IMPROVED AGRICULTURAL IMPLEMENTS

In order to encourage inventors to improve existing implements of cultivation and to design new implements and machines, better suited to Punajb conditions

and within the power of the average cultivator to purchase, the Punjab Government have decided to institute a scheme of prizes. Each year, during the scheme, applications will be invited for a suitable design of a particular improved agricultural implement or machine. These prizes will be open to all, irrespective of nationality. Government servants can compete, subject to the consent of the Government under whom they are employed.

During the current year a prize of Rs. 3,000 is offered, for a suitable design for a bullock-drawn cultivator. The implement must be simple in design ; cheap in cost, so as to be within the purchasing power of an average cultivator ; capable of repairs by an average village blacksmith ; efficient in stirring up fallow land quickly after rain or irrigation, in order to conserve the maximum amount of moisture in the soil, and suitable for the inter-cultivation of crops sown in lines.

The cost of manufacturing the cultivator must not exceed Rs. 15.

Competitors must submit applications setting forth the advantages claimed for their respective designs and accompanied by scale drawings and specifications, which must be sufficiently complete in all details to enable a manufacturer to make the implement.

The applications will be examined by an Expert Committee, which will select for manufacture for trial purposes designs which hold promise of sufficient merit. Applicants whose designs are so selected will be required to deliver the implement in complete working order at Lyallpur or elsewhere in the Punjab within one month of receipt of instructions. Actual pocket expenses up to a maximum of Rs. 50 will be allowed. The award of the Committee will be final.

The entry, for which the prize is awarded, will become the sole property of the Punjab Government, which also reserves the right to postpone or withhold the award of the prize, if no entry of sufficient merit is received.

Applications, complete in all respects, must reach the Director of Agriculture, Punjab, Lahore, by 31st October, 1938, at latest.

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The following communication has been received from the Press Bureau of the International Institute of Agriculture, Villa Umberto, Rome :—

THE INTERNATIONAL INSTITUTE OF AGRICULTURE'S XIVTH GENERAL ASSEMBLY

The XIVth General Assembly of the International Institute of Agriculture will begin on the morning of 23rd May. Delegates of all the Member States of the

Institute will take part in the discussions. The agenda contains the following points :—

(1) General statement by the President of the International Institute of Agriculture.

(2) Report of the General Secretary of the Services and Administration of the Institute.

(3) Report of the Permanent Committee on the financial position.

(4) The instability of farmers' earnings and the means of stabilizing them.

(5) Rôle of the radio and cinema in the technical, vocational and social training of farmers, and in supplying information for consumers.

(6) Rôle of the International Institute of Agriculture in the study of the nutrition problem.

(7) Enquiry into the means of carrying out a world survey of agricultural resources.

(8) Influence of industrial inventions upon agriculture and the marketing of agricultural products (raw materials).

(9) Hygiene in nutrition and agriculture.

(10) Publication by the International Institute of Agriculture of information on the measures taken in the various countries for the improvement of the position of small farmers.

(11) Intensification of the activity of the International Institute of Agriculture regarding studies on agricultural co-operation, and

(12) Unemployment in the country and the resulting decrease in consumption by the rural population.

Some of these questions were included in the agenda by the Permanent Committee of the Institute, others by request of the French, Netherlands, Finnish and Polish Governments.

The meetings of the Assembly will probably last eight days.

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SEVENTH INTERNATIONAL CONGRESS OF GENETICS

In accordance with a resolution of the International Committee and with the decision of the Organising Committee elected by the Genetical Society of Great Britain, the Seventh International Congress of Genetics will meet in Edinburgh in 1939, probably from August 23rd—30th inclusive. Professor F. A. E. Crew, Institute of Animal Genetics, University of Edinburgh, Edinburgh, 9, has been appointed General Secretary to the Congress and to him all correspondence concerning it should be addressed.

ABSTRACTS

Studies in Indian fibre plants. No. 5. Further studies on the inheritance of certain characters in *Hibiscus sabdariffa* L. R. B. Deshpande (*Ind. J. Agric. Sci.* **8**, 229).

The paper describes the results of crosses between the *H. sabdariffa* L. var. *altissima* Wester and the Pusa varieties *H. sabdariffa* var. *albus* and *ruber* which were made to study the inheritance of stem colour, colour of faded corolla, leaf-lobe and hairiness of stem.

Altissima has a green stem with red patches in leaf-axil and just below it, narrow leaf-lobes, and hairy stem. *Albus* has a green and glabrous stem with broad leaf-lobes, and *ruber* has a deep crimson and glabrous stem with broad leaf-lobes. The results indicate that the red patches in *altissima* are due to a group of factors, X, A, B, and W, which is present in the other two parents also. These are concealed by the deep scarlet flush in *ruber* and cannot find expression in the case of *albus* because of the absence of the factor, R, in it. R is necessary for the expression of any colour in the plant. The deep crimson flush of *ruber* is determined by the factor, S, which is present in *albus* and *ruber* but absent in *altissima*. The brown flush which is present in *ruber* but is concealed under its scarlet flush is due to a factor, M, which is present both in *albus* and *ruber* but absent in *altissima*.

In the cross *albus* × *altissima* the segregation of factors, R, S, and M, gave a trihybrid F_2 ratio of 36 Red : 9 Brown : 3 like *altissima* : 16 like *albus*. In the cross between *ruber* × *altissima* the segregation of the factors, S and M, gave a dihybrid ratio of 12 Red : 3 Brown : 1 like *altissima*.

The pink-fading corolla is dominant to yellow-fading corolla on a 3 : 1 monohybrid ratio and is due to a factor, F, which is present in all the three parents but cannot express itself in absence of R. Narrow leaf-lobe is dominant to broad leaf-lobe on a 3:1 monohybrid ratio and is determined by a factor, C. Hairiness of stem is controlled by two cumulative factors, H and H_1, giving a dihybrid ratio of 15 hairy : 1 non-hairy.

The results have been confirmed by F_3 and back-cross data. (*Author's abstract*).

Studies in vernalisation of mustard (A preliminary report). B. Sen and S. C. Chakravarty. (*Ind. J. Agric. Sci.* **8**, 245)

Experiments with mustard (*Brassica juncea* Hooker, Type 27) were undertaken to find out whether mustard seeds could be effectively vernalised and this with a view to their possible agricultural use.

Seeds in two different stages of germination, *viz.*, (A) soon after sproutin and (B) seeds with unsplit seedcoats previously soaked under water for twenty-four hours, were subjected to different periods of low temperature.

Results so far observed from July to October, 1937 sowings alike in pots and in small garden plots clearly indicate that:

(*i*) Plants from both (A) and (B) types of vernalised seeds show definite earliness in the opening of first flowers as compared to the plants from control seeds grown under similar conditions.

(*ii*) For the same dose of chilling the degree of vernalisation induced in sprouted seeds is much greater than that induced in unsplit seeds.

(*iii*) Against this one advantage of the sprouted vernalised seeds, unsplit vernalised seeds offer several and these are of more significant nature for purposes of practical agriculture.

Experiments are planned for this summer (1938), to find out the maximum degree of vernalisation, that can be induced in unsplit seeds by increasing the dose of chilling, and also, to determine the number of days unsplit vernalised seeds can retain the effects of vernalisation when dried.

The expenses of this investigation have been met by grants to this Laboratory from The Elmgrant Trust of Dartington Hall, Totnes, and the Imperial Council of Agricultural Research, New Delhi. (*Authors' abstract*)

Preliminary studies in the respiration of sugarcane *in situ*. K. L. KHANNA AND P. C. RAHEJA. (*Ind. J. Agric. Sci.* **8**, 253).

RESPIRATION studies on eight prominent sugarcane varieties were conducted during an advancing hot weather to study the effect of increasing drought and the response to it shown by different varieties under test. The results that have emerged are as follows:

1. During the day respiration rate was low in the morning; it rose with the rise in temperature till the latter became supra-optimal (about 2-0 P.M.) when this rate fell considerably, the plant tending to regain its normal function with the return of favourable temperatures in the evening.

2. Of the varieties under test some were observed to be more consistent and less fluctuating in the periodic rate of respiration than the others. Co 213 was found to be most susceptible while Co 313 was least affected. Other varieties ranged themselves between these two extremes in the following ascending order namely, Co 299, Co 210, Co 356, Co 326, Co 331 and Co 214.

Varieties with higher concentrations of chlorophyll were observed to possess narrower range of fluctuations in their respiratory activity as compared to those with lower ones, suggesting that higher concentrations afforded greater stability to the vital processes of the plant.

3. In the beginning of hot weather the two hourly fluctuations in the respiratory activity during the day were fairly consistent, but, as the hot weather advanced, these fluctuations became more pronounced so much so that in the third series (23rd May to 2nd June) they were the highest recorded. With the passage of time and possibly through adaptation they narrowed down considerably later in the season.

4. A fair degree of correlation seemed to exist between the magnitude of depression in the respiration rate and the acknowledged drought resistance of different varieties. (*Authors' abstract*)

Soil uniformity trials in the Punjab, I. P. E. Lander, Ramji Narain and Azmat Singh. (*Ind. J. Agric. Sci.* **8**, *271*)

The authors present the data from four soil uniformity test crops and have examined them in a number of different ways. The conclusions derived from a consideration of soil fertility curves and contour maps have been confirmed by a statistical examination of the data in a number of ways. It has been shown that the precision of the experiment in the case of the annual crops does not increase by the application of the method of covariance. Treating the entire area as one compact block of 25 plots (5×5 latin square) shows that the experimental error can be considerably reduced by adopting suitable methods of lay-out.

Two forms of soil heterogeneity are recognised, *viz.*, casual and permanent. It has been shown that the casual fertility may vary with the crop and season, while the permanent fertility is independent of such factors and maintains its level under all conditions. It is concluded that soil heterogeneity as revealed by one crop cannot be a true index of the subsequent behaviour of that area with respect to the same or other crops and consequently the value of uniformity trials in deciding the best form of layout for field experiments to be conducted during subsequent seasons is only limited. (*Authors' abstract*)

Comparison of methods for the estimation of the furfuraldehyde yield of soils and composts. C. N. Acharya. (*Ind. J. Agric. Sci.* **8**, 309)

1. The paper reports a comparison of Powell and Whittaker's bromometric method with the phloroglucinol procedure for the estimation of the total furfuraldehyde yield of soil organic matter.

2. It is shown that the usual Kröber procedure for distillation is inapplicable in presence of soil, on account of excessive bumping, and a method of acid-steam distillation is recommended.

3. The presence of soil seriously interferes in the estimation of furfuraldehyde yield, on account of the oxidizing agents present in the soil, *e.g.*, ferric and manganese compounds, nitrate etc. The recovery may in some cases go down to 40 to 50 per cent of the correct value.

4. A procedure is outlined for removing such interference by the addition of regulated amounts of $SnCl_2$ before distillation. About 1 cc. of 10 per cent $SnCl_2$, per grm. of soil taken, has been found to be sufficient in most cases.

5. An examination of the bromometric and phloroglucinol methods under these conditions, showed that correct values could be obtained for soils by the latter method only, since the slight excess of $SnCl_2$ present produces methyl-furfuraldehyde, which increases the value obtained by the bromometric method. In the phloroglucinol method, however, the interference is much less and could be corrected by treatment of the combined phloroglucides with alcohol.

6. The applicability of the $SnCl_2$-phloroglucinol method to the estimation of the true furfuraldehyde yield of composts, green manures, peats, forest soils and other materials admixed with soil or containing interfering oxidizing agents, is indicated. (*Author's abstract*)

Pruning of fruit trees : The effect of dormant pruning on cropping and vegetative vigour of *phalsa* (*Grewia asiatica*). Lal Singh and Sham Singh. (*Ind. J. Agric. Sci.* **8**, 319)

The heading of *phalsa* bushes to the base in winter is most commonly practised by *phalsa* growers in the Punjab. This widely adopted method of pruning is, for convenience of reference, termed " severe pruning ".

The various degrees of dormant pruning tried are: (*a*). " severe pruning", *i.e.*, cutting the bushes at level with the ground in winter, (*b*) " moderate pruning ", *i.e.*, heading the bushes at a height of 1½—2 feet above ground and allowing new growth to take place on the frame-work thus provided, and (*c*) " light pruning ", *i.e.*, heading the bushes at a height of 3½—4 feet above ground, thus providing a bigger frame-work than in case of the moderately pruned bushes.

Some investigations into the effect of pruning, carried out over a period of six years, show beyond doubt that light pruning of bushes is the best.

The high positive correlation between the number of shoots produced and the yield shows that there is a very close association between them. This point has a practical importance in that increased returns can be obtained by inducing more new growth which can be effected by adopting suitable pruning methods in orchard practice.

Other conditions being equal, the severer the pruning in case of *phalsa* bushes, (*a*) the less the amount of crop (*b*) the less the number of new shoots and (*c*) the worse the quality of fruit, but the greater the size of the fruit. (*Authors' abstract*)

Studies on groundnut nodule organism, I. Isolation of strains and study of cultures. T. Rajagopalan. (*Ind. J. Agric. Sci.* **8**, 331)

Six isolates of groundnut (*Arachis hypogea*) nodule organism were obtained from six varieties of plants grown in two different localities and their morphology and physiology studied. A definite correlation was evinced between the nitrogen fixed by the

various isolates and the differences in their cultural, physiological and bio-chemical characteristics such as gum production, critical hydrogen-ion concentration and 'ferment power'. These differences indicate the possibility of dividing the isolates into efficient and inefficient strains based on simple laboratory tests only. The studies also show that the classification of the isolates on the basis of their 'ferment power' appears to be a simpler and more reliable measure of their efficiency in regard to nitrogen fixation than the carbohydrate consumption. Further, the efficiency or inefficiency of the strains as nitrogen fixers appears to depend more on the location of the nodules than on their number and size. *(Author's abstract)*

Studies on groundnut nodule organism, II. Life-cycle of the organism. T. Rajagopalan. (*Ind. J. Agric. Sci.* **8**, 349)

The life-cycle of a selected strain of the organism has been followed in detail at intervals in a variety of media under different conditions. The organism, has been found to pass through the five stages of Bewley and Hutchinson [1920] namely—pre-swarmer non-motile coccus, pre-swarmer large non-motile coccus, swarmer stage (motile coccus), rod stage (motile) and vacuolated stage—in all the media including soil under aerobic, anaerobic and partial pressure conditions. These stages very often occurred simultaneously but in varying proportions. The size and shape of the cells varied according to the nature of the media. The reproductive processes of the organism appear to take place mostly by budding of cells liberation of gonidia from banded rods and germination from filaments and microcysts. *(Author's abstract)*

Studies on groundnut nodule organism, III. Physiology of the organism: Fermentation characteristics. T. Rajagoplan. (*Ind. J. Agric. Sci.* **8**, 357)

The fermentation characteristics of a selected strain of the organism have been studied with respect to different types of carbohydrates, namely, (*i*) Hexoses-glucose, galactose, mannose and fructose (*ii*) pentose-xylose (*iii*) Disaccharides-sucrose, maltose and lactose, (*iv*) tri-saccharide-raffinose and (*v*) polysaccharide-dextrin. in Ashby's yeast water medium (7·0 pH) containing 1 per cent of the various carbohydrates. Experiments were also conducted to get an insight into the fermentation of glucose by the organism under varied conditions, as influenced by buffer salt, K_2HPO_4 reaction, nitrate, peptone, $CaCO_3$ etc. The studies emphasise, in short, the necessity for a proper control of a culture medium with reference to its composition and reaction for the efficient oxidation of the sugar besides revealing some of the factors retarding the fermentative activities of the organism. The experiment on the 'ferment power' (s:ct ratio, where s is the sugar consumed, c the cell weight, and the period of incubation) also indicates the existence of two distinct phases in the physiology of the organism, the first stage corresponding to a period of great sugar utilisation with less of cell synthesis—, a period of high 'ferment power,' and the second one or maintenance phase of low 'ferment power' when vigorous cell synthesis takes place. *(Author's abstract)*

Studies on groundnut nodule organism, IV. Physiology of the organism : Intermediary metabolism. T. RAJAGOPALAN. (*Ind. J Agric. Sci.* **8**, 379)

IN this part, the intermediary metabolism of the organism with reference to carbon and nitrogen has been studied in Ashby's glucose medium containing $Ca(NO_3)2$ and peptone. Incidentally, a complete carbon balance of the organism has been worked out in Ashby's glucose medium with 0·2 per cent KNO_3 and without $CaCO_3$ or yeast water. The various enzymes present in a culture of the organism were also tested and their probable role in nitrogen fixation, especially that of deaminase and urease, discussed. The products detected and estimated in the fermentation of glucose in Ashby's medium were acetic acid, alcohol, traces of aldehyde, lactic and tartaric acids besides CO_2. The nitrogen content of the bacterial cells has been found to increase with the age of the culture with decreasing C : N ratios. This increase in nitrogen appears to be correlated with the so-called bacteroid or involution stage of the organism. A definite relationship has been observed between the amino acid nitrogen and the NH_3 formed, in peptone cultures. The increase of NH_3 in these cultures is generally associated with corresponding decrease in amino acids. In nitrate cultures the organism has been found to behave as a denitrifier. (*Author's abstract*).

***Babesia bovis*, Starcovici, 1893, as the cause of redwater in an Indian buffalo.** J. A. IDNANI. (*Ind. J. Vet. Sci. and Anim. Husb.* **8**, 99)

HAEMOGLOBINURIC fever in an Indian buffalo ascribable to what appears to be *Babesia bovis* Starcovici, 1893, infection is recorded for the first time in this country. Blood smears from this animal were forwarded to this Institute from one of the military dairy farms with the history of acute piroplasmosis associated with haemoglobinuria. Trypanblue had been administered without producing any beneficial effect. On examination of the smears, the parasites were observed to be much smaller than those of the tropical redwater, *viz., Babesia bigemina* ; the angle at which the pointed ends of the double pears met was widely divergent and in some cases falling in a straight line. The characteristic marginal position of the parasites in the infected red cells was noticed. The morphology of the organisms when compared with that of *Babesia bovis* described by Wenyon (1926) presented no difference. (*Author's abstract*)

Duration of immunity following goat virus vaccination in cattle. R. N. NAIK. (*Ind. J. Vet. Sci. and Anim. Husb.* **8**, 103)

WITH a view to ascertain the duration of immunity conferred to cattle by goat virus vaccination method of prophylaxis which is now extensively resorted to in India for combating rinderpest, an immunity experiment was carried out on four animals—two oxen and two buffaloes—which were subjected to goat virus vaccination on the first December 1932. These four animals were tested, each with 2 c.c. of virulent bull virus on the fifth December 1937 along with two control bulls with the results that the vaccinated animals proved immune to rinderpest. It is, therefore, concluded that the duration of immunity following goat virus vaccination is more than five years. (*Author's abstract*)

Helminthology in relation to veterinary science. H. D. SRIVASTAVA. (*Ind. J. Vet. Sci. and Anim. Husb.* **8**, 113)

THE importance of helminthology in the conservation of public and animal health is often not fully appreciated, as the common symptoms of helminthiasis—a prolonged and progressive afebrile unthriftiness gradually resulting in death—are not always sufficiently spectacular to attract immediate attention. In this paper the author points out that in a tropical country like India, and one in which animal hygiene is little developed, helminthiasis is a most serious menace to the health of stock animals. The losses due to some of the important helminths are discussed and the urgent need of intensive research on the subject is indicated. (*Author's abstract*)

Estimation of total sulphate in blood serum. N. C. DAS GUPTA. (*Ind. J. Vet. Sci. and Anim. Husb.* **8**, 119)

THIS paper describes a method for the determination of total sulphate in blood serum. The hydrochloric acid which usually interferes with the estimation of total sulphates is removed by vacuum evaporation. The optimum acidity required for the quantitative precipitation of sulphates and for keeping the phosphates in solution has also been studied. (*Author's abstract*)

A check and host-list of Ixodoidea (ticks) occurring in India. PURNENDU SEN. (*Ind J. Vet. Sci. and Anim. Husb.* **8**, 133)

THIS article is merely a compilation of a check list and host-list of the Ixodoidea (ticks) of India. (*Author's abstract*)

The following abstracts of articles from the *Indian Forester* have been received from the President, Forest Research Institute, Dehra Dun, and are published here as they are of interest to agricultural workers :—

Biological control of forest insects. J. C. M. GARDNER. (*Ind. For.* LXIII (11) : 769—72. 1937)

CHEMICAL and mechanical methods of controlling insect pests in forestry are limited in their scope of action and results. The principles of biological control by creating conditions favourable to predators and parasites are discussed in connection with the two different problems of (*a*) indigenous insects that reach the status of a pest by the creation of unnatural environmental conditions and (*b*) exotic insects that have been introduced without the parasites or predators that control them in their native habitat. Of the latter type descriptions are given of the control of the gypsy moth and the cottony cushion scale in America and several sugarcane pests in Hawaii, and of the former type, the experimental work now in progress to control the epidemic defoliators in teak plantations in South India. (*M. V. Laurie*)

Note on casuarina equisetifolia plantation in Karwar. D. S. KAIKINI. (*Ind. For.* LXIII (10) : 3 pls. 661-68. 1937).

THE casuarinas first introduced in Karwar in 1868-69 on a small scale now cover 431 acres of narrow sand belts along the coast. The supply of fuel, protection from high winds and storms and aesthetics are among the objects for the plantations. Clear-felling by fifteen years' rotation and artificial planting are adopted with two thinnings in fifth and tenth years . (*Author's abstract*)

Afforestation for villages in the Punjab. R. M. GORRIE (*Ind. For.* LXIII (10) : 712—17. 1937)

THE importance and possibilities of the creation of village forest plantations to provide cheap and plentiful supply of firewood and thereby make proper use of the farmyard manure (instead of burning cow-dung as fuel) were emphasised in the course of a broadcast talk on ' The Punjab's fuel supply ' from the All-India Radio, Delhi. (*M. V. Laurie*)

The measurement of soil erosion and run-off—an attempt and some results. R. M. GORRIE. (*Ind. For.* LXIII (12): 2 pls. 839—46. 1937).

EXAMPLES are given of soil erosion and run-off data actually measured in the U. S. A. ; the type of apparatus used in these experiments is described and some of the difficulties discussed. The first attempts at evolving a similar apparatus for Indian conditions are described. Data so far collected are given, but merely as an indication of the types of error which are to be expected. The Punjab Irrigation Research Institute has collected these figures while reducing the measurements to a standard routine, so that the next step, namely the measurement of erosion on various types of land, can be undertaken with some guarantee of precision. (*Author's abstract*)

The taungyas of the Saharanpur Forest Division, United Provinces. M. D. CHATURVEDI. (*U. P. Bull.* 10: 11 pls. 1—13. 1937)

AFTER previous expensive failures over a number of years, the successful conversion of scrub forest into plantations of more valuable species has been achieved under adverse conditions by the taungya method at a cost of less than Rs. 9 per acre. The land is cleared and cultivated with field crops for two years before sowing up lines of tree species and continues until the trees are too large to permit further agricultural cropping. After that grasses are introduced to provide grazing for village cattle. A number of different tree species are being introduced, with the objects of providing (*i*) leaf fodder, (*ii*) fuel and (*iii*) timber. The organisation of villages for providing labour, details of sowing, cultivation and tending and financial results are discussed. (*M. V. Laurie*)

REVIEWS

Tropical Fruits and Vegetables. An account of their storage and transport. By C. W. Wardlaw. Memoir No. 7, Low Temperature Research Station, Imperial College of Tropical Agriculture, Trinidad, B. W. I. (November 1937)

This memoir is a compilation of the series of articles which the author has published in the various issues of "*Tropical Agriculture*". The author states that, as a rule, tropical fruits are easily subject to wastage and that, therefore, great care is needed in handling them. The use of refrigeration is necessary for making uniform supplies to distant markets.

The most important factor in shipping fruit successfully to overseas market is the refrigerated ship where the temperature is lowered by circulation of cool air in the storage rooms. The absence of this facility is a great handicap to the development of export trade. Facilities for refrigerated transport on land are also equally important. Refrigeration can play a great part in "local food economics" in the tropics and this is made evident by the increase in extent to which it is being applied year after year. The author observes that besides indigenous tropical produce, the cultivation of temperate fruits and vegetables which can be successfully grown in the tropics could be greatly increased for export and for local consumption if refrigeration facilities are available to extend the storage life. The successful cold storage of each type of fruit and vegetable depends upon variety, environmental conditions of growth, the maturity at which it is harvested, the manner in which it is removed to the cold storage, temperature, humidity, duration of storage and the time required for distribution on removal from storage. The influence of pre-storage conditions on the subsequent storage life makes it necessary that every country must work out the optimum conditions of storage for their own fruits and vegetables.

The author states that the literature on the subject of cold storage of tropical fruits and vegetables is very scanty and at the same time widely scattered and fragmentary. The author has collected together the available information about the storage requirements of over thirty different kinds of fruits and of about forty different kinds of vegetables. The results of the storage trials of a particular fruit

or vegetable made by various investigators in different countries have thus been brought together. The data on most of the fruits and vegetables are very limited. Somewhat detailed information is available for the fruits, Avacado, Banana, Orange, Grapefruit, Lime, Melon, Mango, Papaya and Pineapple and for the vegetables, Asparagus, Celery, Cucumber, Onion, Potato, Sweet-potato and Tomato.

The data on the storage requirements of a particular fruit or vegetable as given by different investigators vary greatly and it is, therefore, difficult to recommend a storage temperature or a set of suitable storage conditions without carrying out storage trials locally. The author thinks that the data are useful in arranging such local trials and may serve as a guide. It has been observed by the author that tropical produce generally requires higher storage temperatures in order that chilling due to low temperatures may be avoided. The tolerance of low temperatures varies from fruit to fruit. Avacado is very susceptible to chilling. Mango grown in Trinidad is chilled at a temperature lower than 48° F. and Papaya is held at temperatures lower than 55°—60° F. Varieties are found to vary in their power of cold resistance. For example, it appears from the studies conducted on banana grown in Trinidad that the Cavendish variety is slightly more cold resistant than the Gros Michel which is usually transported at a temperature of 53° F. The Lactacan and the Congo are less cold resistant and require a hold-temperature of 58°—60° F. For the Giant Governor the storage temperature lies in the vicinity of 56°—58° F. The Red banana carries well in storage at 53° F. In the discussion on the chilling of banana the author has made it clear that, during the overseas transport of fruit, it is not only necessary to apply refrigeration at the tropical end but, it may be necessary to supply heat to the holds as the temperate regions with cold winters are approached.

The study contained in the memoir is undoubtedly very useful both as regards its value to research workers and to those interested in commercial cold storage. The author has put together the results of various investigations in a clear and systematic manner. [G. S. C. & D. V. K.].

Mysore Agricultural Calendar, 1938. Issued by the Department of Agriculture, Mysore State. Price 2 As.

The practice of giving information in a calendar form has always been looked upon as valuable as it draws attention of the reader to definite dates on which certain operations are to be performed. This is particularly useful in a subject like agriculture where the key-note of success depends on performing the operations

at the right times. In the calendar cattle fairs, shows, and agricultural exhibitions are noted against their dates. In addition, the book contains a fairly large number of articles on present-day subjects and monthly notes on different crops. The following are some of these :—

" Cotton as a New Crop in the Irwin Canal Tract ", "Sowing New Strains of Paddy" and "Co-operative Experiments in Agriculture". A list of the staff of both the Agricultural and Veterinary Departments and publications issued by these Departments are given. The publication is illustrated. [R. L. S.]

NEW BOOKS
On Agriculture and Allied Subjects

Crystal Chemistry. By Charles W. Stillwell, Research Chemist, Dennison Manufacturing Co., (McGraw-Hill Publishing Co., Ltd., Aldwych House, London W. C. 2). Price 25/- net.

Sixty Years of Botany in Britain (1875 – 1935). Impressions of an Eye-witness. By F. O. Bower, Sc. D., LL.D., F.R.S., Emeritus Professor of Botany in the University of Glasgow (MacMillan and Co., Ltd., London, W. C. 2). Price 10*s*. 6*d*. net.

The Chemical Analysis of Foods—A Practical Treatise on the Examination of Foodstuffs and the Detection of Adulterants. By H. E. Cox, Ph.D., D.Sc., F.I.C. New (2nd) Edition, 41 Illustrations. (J. & A. Churchill, 104, Gloucester Place, London, W. 1). Price 21*s*.

Clowes and Coleman's Quantitative Chemical Analysis. Edited and revised by D. Stockdale, Ph.D., A.I.C., and J. Dexter, B.Sc., A.I.C. New (14th) Edition, 130 Illustrations. (J. & A. Churchill, 104, Gloucester Place, London, W. 1). Price 18*s*.

Hackh's Chemical Dictionary (containing the words generally used in Chemistry, many of the terms used in the Related Sciences, with their pronunciations). By Ingo W. D. Kackh, F.A.I.C., F.R.S.A. New (2nd) Edition, 1,030 Pp. Fully illustrated. (J. & A. Churchill, 104, Gloucester Place, London, W. 1). Price 48*s*.

Bolles Lee's Microtomist's Vade-Mecum. A Handbook of the Methods of Animal and Plant Microscopic Anatomy. By J. Bronte Gatenby, Ph.D., D.Sc., and Theophilus S. Painter, A.M., Ph.D., with the collaboration of ten specialist contributors. New (10th) Edition. 11 Illustrations. (J. & A. Churchill, 104, Gloucester Place, London, W. 1). Price 30*s*.

A Textbook of Plant Virus Diseases. By Kenneth M. Smith, D.Sc., Ph.D., F.R.S. 101 Illutstrations. (J. & A. Churchill, 104, Gloucester Place, London, W. 1). Price 21*s*.

Recent Advances in Entomology. By A.D. Imms, D.Sc., F.R.S. New (2nd) Edition. 94 Illustrations. (J. & A. Churchill, 104, Gloucester Place, London, W. 1). Price 15*s*.

Physiological Genetics. A notable pioneering work by an internationally known authority. By Richard Goldschmidt. 375 Pp. Illustrated. (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W. C. 2). Price 24/- net.

Forest Pathology. A reference book on the diseases of forest trees and forest products. By John Shaw Boyce. 600 Pp., 216 Illustrations. (The American Forestry Series). (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W. C. 2). Price 30/- net.

The Physiology of Domestic Animals. By H H. Dukes, D. V. M., M.S. 4th Revised Edition. (Bailliere, Tindall and Cox. 1937). Price 30*s*. net.

Through Science to Philosophy. By Professor Herbert Dingle. (Oxford : Clarendon Press, London : Oxford University Press. 1937). Price 15*s*. net.

The Relief of Pain : A Handbook of Modern Analgesia. By Harold Ralme. (J. & A. Churchill, 104, Gloucester Place, London, W. 1). Price 12*s*. 6*d*.

Recent Advances in Endocrinology. By A. T. Cameron, Professor of Biochemistry, University of Manitoba. (J. & A. Churchill, 104, Gloucester Place, London, W. 1). Price 15*s*.

The Thyroid and Its Diseases. By J. H. Means, M.D. (J. B. Lippincott Company, Philadelphia and London. 1937). Price 25*s*.

Biological Standardisation of the Vitamins. By K. B. Coward, D.Sc., Reader in Biochemistry, University of London. (London : Bailliere, Tindall and Cox. 1938). Price 12*s*. 6*d*.

Biological Standardisation. By J. H. Burn, M.D. (Oxford University Press. London : Humphrey Milford. 1937). Price 21*s*.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

British India

Press Communique dated the 8th June 1938, issued by the Government of India in the Department of Education, Health and Lands.

It has been brought to the notice of the Government of India that consignments of plants (other than fruits and vegetables intended for consumption and potatoes) are being sent to India from Burma without the health certificate prescribed in the Third Schedule published with the Government of India, Department of Education, Health and Lands Notification No. F. 320/35-A., dated the 20th July, 1936. It is essential that the conditions in the rules published in the notification referred to should be strictly observed and for the information of those interested, it is notified that consignments will not be passed for clearance by the Customs Authorities in India at the port of disembarkation after the 31st July, 1938, unless accompanied by health certificates in the prescribed form.

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Plant Quarantine Regulations and Import Restrictions relating to the following countries have been received in the Imperial Council of Agricultural Research. Those interested are advised to apply to the Secretary, Imperial Council of Agricultural Research for full particulars :—

Summaries of Plant Quarantine Import Restrictions issued by the United States Department of Agriculture, Bureau of Entomology and Plant Quarantine of:—

1. Union of South Africa.
2. British Gold Coast Colony.
3. Kingdom of Italy.
4. Japan.
5. French Colonies (Oceania).
6. French zone of Morocco.
7. Kingdom of Egypt.
8. Modifications of Pink Bollworm Quarantine Regulations.
9. Plant Quarantine Restrictions of the United States of America.

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Burma

Notification No. 29, dated the 2nd November 1937, issued by the Government of Burma, Department of Agriculture and Forests.

In exercise of the powers conferred by sub-section (*1*) of section 3 of the Destructive Insects and Pests Act, and in supersession of the notification of the Government of India in the Department of Education, Health and Lands, No F320/35A, dated the 20th July 1936, the Governor makes the following order for the purpose of prohibiting, regulating and restricting the import into Burma of the articles hereinafter specified.

1. In this order—

(*i*) " Official certificate " means a certificate granted by the proper officer or authority in the country of origin ; and the officers and authorities named in the third column of the first Schedule appended hereto are the proper officers and authorities to grant, in the countries named in the second column, the certificates required by the provisions referred to in the first column thereof ;

(*ii*) " Plant " means a living plant or part thereof but does not include seeds ; and

(*iii*) all provisions referring to plants or seeds shall apply also to all packing material used in packing or wrapping such plants or seeds.

2. No plant shall be imported into Burma by means of the letter or sample post ; provided that sugarcane for planting intended to be grown under the personal supervision of the Deputy Director of Agriculture, East Central Circle, Pyinmana, may be imported by him by such post.

3. No plant shall be imported into Burma by air ; provided that plants which are infested with living insects and are intended for the introduction of such living insects may be so imported if they are accompanied by a special certificate from the Entomologist, Burma, that such plants are imported for the purpose of introducing such insects and provided also that sugarcane may be imported by air by the Deputy Director of Agriculture, East Central Circle, Pyinmana, if the conditions of paragraph 9 are satisfied.

4. No plants other than fruits and vegetables intended for consumption and potatoes shall be imported into Burma by sea except after fumigation with hydrocyanic acid gas and at the port of Rangoon.

Provided that plants which are infested with living parasitized insects and are intended for the introduction of such parasites may be imported without such fumigation if they are accompanied by a special certificate from the Entomologist, Burma, that such plants are imported for the purpose of introducing such parasites.

Provided also that rubber plants, stumps and bud wood which the certificate required by paragraph 5 shows to have been grown in Sumatra or in the Federated Malay States may be imported without such fumigation at any port within the Tenasserim Division of Burma or at Rangoon.

5. No plants, other than fruits and vegetables intended for consumption, and potatoes, shall be imported into Burma by sea unless accompanied by an official certificate in the form prescribed in the second Schedule that they are free from injurious insects and diseases.

6. Potatoes shall not be imported into Burma by sea or by air except from India unless they are accompanied by—

(*a*) a certificate from the consignor stating fully in what country and in what district of such country the potatoes were grown and guaranteeing that wart disease was not known to exist on the farms where the potatoes were grown ; and

(*b*) an official certificate that no case of wart disease of potatoes has been known during the twelve months preceding the date of the certificate within five miles of the place where the potatoes were grown.

Provided that potatoes may be imported from Italy if they are accompanied by a certificate of freedom from disease granted by a Royal Phytopathological Institute in Italy.

7. Rubber plants shall not be imported into Burma by sea unless, in addition to the general certificate required under paragraph 5 they are accompanied by an official certificate that the estate from which the plants have originated or the individual plants are free from Fomes semitostus, Sphaerostilbe repens, Fusicladium macrosporium and Oidium heveae.

8. No lemon plants, lime plants, orange plants, grape-fruit plants or other citrus plants and no cuttings of such plants shall be imported into Burma unless, in addition to the general certificate required under paragraph 5 they are accompanied by an official certificate that they are free from the Malde Secco (Deuterophoma tracheiphila) or that the disease does not exist in the country in which they were grown.

9. (1) The importation of sugarcane into Burma by sea from the Fiji Islands, New Guinea, Australia or the Philippine Islands is prohibited absolutely.

(2) The importation of sugarcane into Burma by sea or by air from any other country is prohibited unless by or through the Deputy Director of Agriculture, East Central Circle, Pyinmana, and unless accompanied by an official certificate

that it has been examined and found free from cane borers, scale insects, aleurodes, root disease (any form), pine-apple disease (Thielaviopsis paradoxa), sereh dwarf disease, leaf scald and cane gummosis, that it was obtained from a crop which was free from mosaic and streak diseases, and that the Fiji disease of sugarcane does not occur in the country of export.

(3) All importations of sugarcane shall be made by or through the Deputy Director of Agriculture, East Central Circle, Pyinmana, who on receipt of the cane shall grow it in quarantine under his personal supervision for a period of at least one year and shall destroy any plants with fire in the event of any pest or disease not hitherto recorded in Burma manifesting itself.

10. Hevea rubber plants and Hevea rubber seeds shall not be imported into Burma from America or from the West Indies except by the Director of Agriculture, Burma

11. (*a*) Seeds of flax, bersim (Egyptian clover) and cotton shall not be imported by air or by letter or sample post, otherwise than by sea.

(*b*) The importation of 'Mexican Jumping Beans' (Sebastiania palmeri of the family Euphorbiaceae) is prohibited absolutely.

12. Coffee plants, coffee seeds and coffee beans shall not be imported into Burma except for experimental planting purposes only by the Director of Agriculture, Burma, who shall take all measures necessary to ensure that such coffee plants, beans or seeds as are imported by him are free from plant diseases and injurious insects. Provided that the prohibition hereinbefore contained shall not apply (*i*) to roasted and ground coffee, or (*ii*) to a consignment of unroasted or unground coffee beans or seeds produced in India and covered by a certificate of origin in the form set forth in the third Schedule appended hereto and signed by one of the authorities specified in the fourth Schedule appended hereto.

13. Flax seeds and bersim (Egyptian clover) seeds shall not be imported into Burma by sea, unless the consignee produces before the Collector of Customs a licence from the Director of Agriculture, Burma, in that behalf.

14 (1) Unginned cotton shall not be imported by sea or by air.

(2) Cotton seeds shall not be imported by sea save for experimental purposes by the Deputy Director of Agriculture, Myingyan Circle, Meiktila, and shall not be so imported by such officer save at the port of Rangoon and in quantities not exceeding one hundredweight in any one consignment and on condition that it will be fumigated on importation with carbon bisulphide.

15. Nothing in these rules shall be deemed to apply to any article brought by sea or by air from one port or place in Burma to another such port or place.

FIRST SCHEDULE [Paragraph 1 (*i*)]

Paragraph (1)	Country of origin (2)	Authority (3)
6 (*b*)	Great Britain and Ireland.	The Ministry of Agriculture and Fisheries, England.
		The Department of Agriculture, Scotland.
		The Ministry of Agriculture, Northern Ireland.
		The Department of Agriculture and Technical Instruction for Ireland.
	Sweden	The Ministry of Agriculture.
	Norway	The Norwegian Board of Agriculture.
	Denmark	The Ministry of Agriculture.
	France	Do.
	Japan (including Formosa).	The Ministry of Agriculture and Forestry.
	Italy	The Ministry of Agriculture.
	Kenya Colony	The Department of Agriculture.
	Australia	Chief Quarantine Officer for plants.
	Newzealand	The Department of Agriculture, Industries and Commerce, Wellington.
	Holland	The Department of Agriculture.
	Germany	Do.
	Hungary	Royal Hungarian Service for Protection of Plants (M. Kir Novenyvedelmi Szolgalat).
	*Other countries	The Ministry or Department of Agriculture of the country concerned.
7	Ceylon	The Department of Agriculture.
	Malay Peninsula	The Department of Agriculture, Straits Settlements and Federated Malay States.
	Dutch Indies	The Department of Agriculture, Industry and Commerce.
	Belgian Congo	Do.
	Kenya Colony	The Department of Agriculture.
	Uganda Protectorate	Do.
	Nyassaland	Do.
	South Africa	The Union of South Africa, Department of Agriculture.
	Japan (including Formosa).	The Ministry of Agriculture and Forestry.
	Madras	The Department of Agriculture.
	Other countries	The Ministry or Department of Agriculture of the country concerned.
8	Italy	The Ministry of Agriculture, Royal Italian Phytopathological Institute.
	Greece	Ministry of Agriculture.
	Palestine	Department of Agriculture and Forests.

*When a Customs officer receives a certificate required by clause (*b*) of rule 6 from any country not specified by name in the part of the schedule which relates to such certificate, he shall after passing the consignment forward the certificate to the Ministry of Agriculture and Forests, for information.

FIRST SCHEDULE—*contd.*

Paragraph (1)	Country of origin (2)	Authority (3)
	South Africa . .	The Union of South Africa, Department of Agriculture.
	Northern Rhodesia	The Department of Agriculture.
	Southern Rhodesia	Do.
	Madras . . .	Do.
	Bombay . .	Do.
	Bengal . . .	Do.
	Central Provinces .	Do.
	United Provinces .	Do.
	Other countries .	The Ministry or Department of Agriculture of the country concerned.
9	Dutch Indies . .	The Department of Agriculture, Industry and Commerce.
	Mauritius . .	The Department of Agriculture.
	Philippine Islands .	The Bureau of Agriculture.
	Japan (including Formosa).	The Ministry of Agriculture and Forestry.
	South Africa . .	The Union of South Africa, Department of Agriculture.
	Egypt . . .	The Ministry of Agriculture.
	West Indies . .	The Imperial College of Tropical Agriculture, St. Augustine, Trinidad.
	Windward and Leeward Islands.	Advisory Department of Agriculture at the Imperial College.
	British Guiana .	The Department of Science and Agriculture.
	Trinidad . .	The Department of Agriculture.
	Jamaica . .	Do.
	United States. .	Do.
	Ceylon . . .	Do.
	Malay Peninsula .	The Department of Agriculture, Straits Settlements and Federated Malay States.
	Kenya Colony .	The Department of Agriculture.
	Queensland . .	The Department of Agriculture and Stock.
	Madras . . .	The Department of Agriculture.
	Other countries .	The Ministry or Department of Agriculture of the country concerned.

SECOND SCHEDULE (Paragraph 5).

CERTIFICATE

This is to certify that the plant(s), living plant(s) or plant products (Strike out the words not applicable) included in the consignment, of which particulars are given below, were/was thoroughly examined on the (date) by (name) , a duly authorized official of the and found to be healthy, no evidence of the presence of any injurious insect, pest, or

SECOND SCHEDULE—*contd.*

disease [destructive to agricultural or horticultural crops or to trees or bushes having been found in/on them and that the consignment (including the packing) covered by this certificate has/has not been treated in the following manner (*e.g.* fumigated with or disinfected with)] $\frac{\text{prior}}{\text{immediately subsequent}}$ to inspection. $\frac{\text{Inspected}}{\text{Not inspected}}$ in the field by a duly authorized inspector on

(Signature)

(Official status)

Date

Number and description of packages

Distinguishing marks

Description of plants or plant products or parts thereof

Stated to be grown at

Exported by

Name and address of consignee

Name of vessel or particulars of route

Date of shipment

Port or place of entry

Additional Certificate(s) attached

(Give here details of any special certificate or certificates issued in respect of imports specifically scheduled.)

THIRD SCHEDULE (Paragraph 12).

CERTIFICATE OF ORIGIN FOR INDIAN COFFEE BEANS OR SEEDS

Name of Consignor	Name of Consignee	Gross Weight	Number of packages	Mark of each package	Name of District in which produced

THIRD SCHEDULE—*contd.*

Certified that the above consignment of raw coffee beans or seeds is Indian produce grown in the district specified above.

Signature of certifying authority.
No. of Railway Receipt or
No. of Bill of Lading
Signature of Consignor.

FOURTH SCHEDULE (Paragraph 12).

Certifying authority :—

(*i*) The Assistant Director of Agriculture, Chickmagular, Kadur District, Mysore State.

(*ii*) The Director of Agriculture and Fisheries, Travancore State.

(*iii*) The Director of Agriculture, Cochin Government.

(*iv*) The Director of Agriculture, Madras Presidency.

(*v*) Any other officer whom the Government of Madras may appoint in this behalf by notification in the Fort St. George Gazette.

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

Imperial Council of Agricultural Research

MR. N. C. MEHTA, I.C.S., Secretary, Imperial Council of Agricultural Research, has been granted leave on average pay for five months with effect from the 30th June 1938 (forenoon).

MR. SUBIMAL DUTT, I.C.S., Under-Secretary, Imperial Council of Agricultural Research, was appointed to officiate as Secretary, Imperial Council of Agricultural Research, with effect from the 30th June 1938 (forenoon) until further orders, *vice* MR. MEHTA, granted leave.

MR. S. BASU, I.C.S., has been appointed as Secretary, Imperial Council of Agricultural Research, with effect from the 18th July 1938 (forenoon).

Under Rules 1 (21) and 43 (15) of the Rules and Regulations of the Imperial Council of Agricultural Research, the Governor-General in Council has been pleased to appoint DR. T. E. GREGORY, D.Sc., Economic Adviser to the Government of India, as a member of the Imperial Council of Agricultural Research and its Advisory Board, with effect from the 4th July 1938.

Under Rules 1 (21) and 43 (15) of the Rules and Regulations of the Imperial Council of Agricultural Research, the Governor-General in Council has been pleased to reappoint SARDAR BAHADUR DATAR SINGH, Proprietor, Cattle and Dairy Farm, Montgomery, as a member of the Imperial Council of Agricultural Research and its Advisory Board for a period of three years with effect from the 3rd July 1938.

Under Rule 1 (17) of the Rules and Regulations of the Imperial Council of Agricultural Research, the Indian Tea Association and the United Planters' Association of South India have jointly re-elected MR. P. H. CARPENTER, F.I.C.,

as their representative on the Imperial Council of Agricultural Research, with effect from the 23rd May 1938.

Under Rule 1 (7) of the Rules and Regulations of the Imperial Council of Agricultural Research, the Federation of Indian Chambers of Commerce and Industry have elected MR. DEBI PRASAD KHAITAN as the representative of the Indian Business community on the Imperial Council of Agricultural Research, with effect from the 23rd May 1938 in the vacancy caused by MR. CHUNILAL B. MEHTA's relinquishing his membership of the Council.

Under Rule 1 (3) of the Rules and Regulations of the Imperial Council of Agricultural Research, the following persons have been renominated by the Provincial Governments concerned as the representatives of the respective Provincial Veterinary Departments on the Council :—

By the Madras Government

1. MR. P. T. SAUNDERS, O.B.E., M.R.C.V.S., I.V.S., Director of Veterinary Services, Madras, with effect from the 23rd May 1938.

By the Bombay Government

2. MR. E. S. FARBROTHER, M.R.C.V.S., I.V.S., Director of Veterinary Services, Bombay, with effect from the 30th May 1938.

By the Bengal Government

3. MR. P. J. KERR, M.R.C.V.S., I.V.S., Director of Civil Veterinary Department and Veterinary Adviser to the Government of Bengal, with effect from the 23rd May 1938.

By the Government of Bihar

4. MR. MOHAMMAD ISMAIL MALIK, M.R.C.V.S., Director of Veterinary Services, Bihar, with effect from the 23rd May 1938.

By the Government of Assam

5. RAI SAHIB SRISH CHANDRA GHOSH, G.B.V.C., Superintendent, Civil Veterinary Department, Assam, with effect from the 23rd May 1938.

By the Government of North-West Frontier Province

6. KHAN SAHIB S. M. A. SHAH, B.Sc., M.R.C.V.S., Superintendent, Civil Veterinary Department, North-West Frontier Province, with effect from the 23rd May 1938.

Under Rule 1 (18) of the Rules and Regulations of the Imperial Council of Agricultural Research, the Indian Central Cotton Committee have elected RAO BAHADUR SIR MADHORAO DESHPANDE, K.B.E., Honorary Magistrate, Nagpur, as their representative on the Imperial Council of Agricultural Research, *vice* SARDAR RAO BAHADUR BHIMBHAI RANCHODJI NAIK, Sagrampura, Surat, whose membership of the Council terminated under the provisions of Rule 5 (3) of the said Rules and Regulations.

MR. A. M. THOMSON, Senior Marketing Officer, has been granted earned leave for 30 days combined with extraordinary leave for 22 days with effect from the 25th July 1938, with permission to prefix to his leave Sunday, the 24th July 1938.

The services of MR. JAIKARAN NATH UGRA, M.A., LL.B., P.C.S., have been replaced at the disposal of the Government of the United Provinces, with effect from the 22nd July 1938.

Indian Central Cotton Committee

In consequence of vacancies caused by the retirement of nominated members from the 1st April 1938, the following have been nominated to be members of the Indian Central Cotton Committee, Bombay :—

By the Central Government

(i) Director of Agriculture, Punjab, to represent the Agriculture Department, Punjab.

(ii) MR. GIRIJA PROSANNA CHAKRAVERTY to represent Bengal.

(iii) MR. YASHWANTRAM RAJARAM JOSHI, as the representative of the cotton-growing industry in Bombay.

(iv) CH. MOHAMMAD YASIN KHAN, M.L.A., as the representative of the cotton-growing industry in the Punjab.

By the Baroda State

(i) MR. R. G. ALLAN, C.I.E.

The Governor-General in Council has been pleased to appoint the following gentlemen as additional members of the Indian Central Cotton Committee :—

(i) MR. MANGESH BABHUTA PATEL, M.L.A., of Shahada, District West Khandesh, to represent the cotton-growing industry in Bombay.

(ii) RAI BAHADUR S. V. KANUNGO, as a representative of the Indore State (Reappointed).

(iii) SARDAR RAO BAHADUR BHIMBHAI RANCHODJI NAIK.

The Governor-General in Council has been pleased to appoint DR. T. E. GREGORY, D.Sc., Economic Adviser to the Government of India to be an additional member of the Indian Central Cotton Committee.

Indian Central Jute Committee

LT.-COL. C. A. MACLEAN, I.A.S., Officiating Director of Agriculture, Bihar, has been nominated by the Government of Bihar to be a member of the Indian Central Jute Committee, *vice* MR. D. R. SETHI, on deputation with the Central Government.

MR. J. R. WALKER, M.L.A. (of Messrs. McLeod and Co., Ltd., Calcutta), has been nominated by the Indian Jute Mills' Association, Calcutta, to be a member of the Indian Central Jute Committee, *vice* MR. H. H. BURN, resigned.

Imperial Agricultural Research Institute

DR. J. A. MULYIL, B.A., Ph.D. (Dublin), (T. C. D.), Lecturer in Zoology, Agricultural College, Coimbatore, has been appointed on probation to the temporary post of the Biological Control Research Officer at the Imperial Agricultural Research Institute, New Delhi, with effect from the 9th May 1938 (forenoon).

Imperial Veterinary Research Institute

MR. J. R. HADDOW, B.Sc., M.R.C.V.S., D.V.S.M., I.V.S., Veterinary Research Officer in charge of the Serological Section, Imperial Veterinary Research Institute, Mukteswar, has been appointed to officiate as Director, Imperial Veterinary

Research Institute, with effect from the 21st May 1938 (afternoon), until further orders, *vice* MR. F. WARE, C.I.E., F.R.C.V.S., I.V.S., appointed as Animal Husbandry Expert to the Imperial Council of Agricultural Research.

CAPTAIN S. C. A. DATTA, B.Sc., M.R.C.V.S., A.I.R.O., Veterinary Research Officer in charge of the Protozoological Section, Imperial Veterinary Research Institute, Mukteswar, has been granted leave, *ex*-India, on average pay, for eight months with effect from the 11th July 1938, or the date from which he may avail himself of it.

During the absence of CAPTAIN DATTA, MR. S. K. SEN, M.Sc., F.E.S., Entomologist, Imperial Veterinary Research Institute, has been appointed to officiate as Veterinary Research Officer in charge of the Protozoological Section, Imperial Veterinary Research Institute.

MR. R. L. KAURA, B.V.Sc., M.R.C.V.S., Assistant Serologist, Imperial Veterinary Research Institute, has been appointed to the temporary post of Veterinary Research Officer in charge of the Serological Section, Imperial Veterinary Research Institute, with effect from the 21st May 1938 (afternoon), until further orders.

Imperial Institute of Sugar Technology

MR. R. C. SRIVASTAVA, O.B.E., B.Sc., Director, Imperial Institute of Sugar Technology, was granted leave on average pay from the 9th May 1938 to the 25th June 1938 with permission to prefix Sunday, the 8th May and affix Sunday, the 26th June and the holiday on Monday, the 27th June 1938.

MR. C. W. P. VAN DER MEYDEN, Professor of Sugar Technology, Imperial Institute of Sugar Technology, was appointed to officiate as Director of the Institute in addition to his own duties, *vice* MR. R. C. SRIVASTAVA, granted leave.

Madras

MR. P. T. SAUNDERS, O.B.E., M.R.C.V.S., I.V.S., Director of Veterinary Services, has been granted leave on average pay for three months and one day and

on half average pay for twenty-three days in continuation with effect from the 24th June 1938 or date of relief.

MR. T. J. HURLEY, M.R.C.V.S., D.V.S.M., I.V.S., Principal, Madras Veterinary College, has been appointed to act as Director of Veterinary Services, with effect from date of joining, *vice* MR. P. T. SAUNDERS, granted leave.

MR. M. R. V. PANIKKAR, B.Sc., M.R.C.V.S., Lecturer in Hygiene, Resident Veterinary Officer and Personal Assistant to the Principal, Madras Veterinary College, to act as Principal, Madras Veterinary College, with effect from date of taking charge, *vice* MR. T. J. HURLEY, I.V.S., on other duty as Acting Director of Veterinary Services.

MR. A. K. MITRA, M.R.C.V.S., Acting Lecturer in Surgery, Madras Veterinary College, has been appointed as Lecturer in Hygiene, Madras Veterinary College, *vice* MR. M. R. V. PANIKKAR, on other duty until further orders.

MR. SAADAT-UL-LAH KHAN, M.A. (Oxon.), I.A.S., Deputy Director of Agriculture, IV Circle, St. Thomas' Mount, has been transferred as Deputy Director of Agriculture, III Circle (reorganized), Trichinopoly, with effect from date of taking charge.

MR. Y. G. KRISHNA RAO NAYUDU, C.D.A. (Edin.), Officiating Deputy Director of Agriculture, II Circle (old), Guntur, has been transferred as Assistant Director of Agriculture, Guntur, with effect from date of taking charge.

MR. C. RAMASWAMI NAYUDU, B.A. (Cantab.), Officiating Deputy Director of Agriculture, VIII Circle (old), Coimbatore, has been appointed Lecturer in Agriculture, Agricultural College, Coimbatore, with effect from date of taking charge.

MR. K. T. ALWA, L.Ag., Officiating Headquarters Deputy Director, has been appointed Headquarters Deputy Director.

RAO SAHIB M. ANANTANARAYANA RAO, G.M.V.C., Lecturer in Parasitology, Madras Veterinary College, has been appointed to act also as Resident Veterinary Officer and Personal Assistant to the Principal, Madras Veterinary College, without prejudice to his present duties as Lecturer in Parasitology.

MR. PAUL D. KARUNAKAR, B.Sc. (IOWA), M.Sc. (New Jersey), Agricultural Bacteriologist, has been granted an extension of leave on medical certificate for one month from 1st June 1938.

On return from leave MR. K. S. NAYAR, G.B.V.C., M.R.C.V.S., Lecturer in Surgery, Madras Veterinary College, has been appointed Superintendent, Serum Institute, Madras, with effect from date of taking charge.

Bombay

MR. W. J. JENKINS, M.A., B.Sc. (Edin.), I.A.S., Director of Agriculture, has been granted leave on average pay for four months combined with leave on half average pay for two months and twenty-eight days with effect from 22nd April 1938 or the subsequent date of relief.

MR. B. S. PATEL, N.D.D., N.D.A., C.D.A.D., I.A.S., Principal and Professor of Agriculture, Agricultural College, Poona, has been appointed officiating Director of Agriculture, *vice* MR. JENKINS, granted leave.

RAO BAHADUR V. A. TAMHANE, M.Ag., M.Sc., I.A.S., has been appointed officiating Principal and Professor of Agriculture, Agricultural College, Poona, *vice* MR. B. S. PATEL.

MR. H. G. BALUCH has been appointed to officiate as Deputy Director of Agriculture, Gujarat, *vice* RAO BAHADUR V. A. TAMHANE.

The Governor of Bombay has been pleased to appoint MR. M. MOHEY-DEEN, M.R.C.V.S., Principal, Bombay Veterinary College, *vice* RAO BAHADUR V. R. PHADKE, retired,

MR. B. S. KADAM, B.Sc. (IOWA), M.Sc. (Cornell), Crop Botanist to Government, Karjat, has been granted leave on half average pay out of India for one year and eight months with effect from 1st August 1938 or the subsequent date of relief.

RAO SAHEB G. L. KOTTUR, Cotton Breeder, S.M.C., Dharwar, has been granted leave on average pay for one month with effect from the 1st July 1938 or subsequent date of relief.

Bengal

MR. H. C. E. PETERSON, Agricultural Engineer, Bengal, has been granted leave on average pay for the period from 2nd July to the 31st October, 1938, with permission to prefix and affix gazetted holidays on the 1st July and 1st and 2nd November, 1938, respectively to his leave.

MR. W. M CLARK, M B.E , B.Sc., I.A.S., has been appointed to act as Assistant Director of Agriculture, Bengal, in addition to his own duties as Deputy Director of Agriculture, Eastern Circle, *vice* MR. P. C. CHAUDHURI, on leave.

MR. INDU BHUSAN CHATTERJI, Physiological Chemist, has been appointed to act as Agricultural Chemist in the Bengal Higher Agricultural Service, *vice* MR. GOSTA BEHARI PAL, on leave.

United Provinces

The Governor has been pleased to accept the resignation of MR. SHRI KRISHNA DUTTA PALIWAL, M.L.A. (Central), of the post of Rural Development Officer, United Provinces, with effect from the 16th February 1938.

MR. M. D. CHATURVEDI, I F.S., has been appointed as temporary Rural Development Officer, United Provinces, with effect from 2nd May 1938.

MR. RAJESHWARI PRASAD MATHUR, M.A., member of the United Provinces Civil Service (Executive branch), has been appointed to the temporary post of Cane Development Officer, with effect from the date he assumes charge.

MR. C. H. PARR, I.A.S., Deputy Director of Agriculture, Bundelkhand Circle, Jhansi, has been granted leave on average pay for two months in India followed by leave on average pay for three months and on half average page for one month out of India, with effect from 1st April 1938, or subsequent date.

MR. P. S. VISHWANATHAN, Agricultural Engineer, Cawnpore, has been granted leave on average pay for four months with effect from the 20th May 1938, or subsequent date.

SAIYID SIRAJUL HASSAN, Assistant Agricultural Engineer, Sarda Circle, Lucknow, has been appointed to officiate as Agricultural Engineer, Cawnpore, *vice* MR. P. S. VISWANATHAN, granted leave.

DR. A. K. MITRA, M.Sc. (London), Ph.D. (Cantab.), Assistant Professor of Botany, Agricultural College, Cawnpore, in the United Provinces Agricultural Service, Class II, has been appointed to be temporary Economic Botanist (Sugarcane and Paddy) in the United Provinces Agricultural Service, Class I, with effect from the 1st May 1938 or subsequent date of relief.

Punjab

On return from deputation to Bahrain KHAN BAHADUR MAULVI FATEH-UD-DIN, M.B.E., I.A.S., Deputy Director of Agriculture, Jullundur, has been appointed to officiate as Director of Agriculture, Punjab, with effect from the 31st May 1938 (afternoon), *vice* MR. H. R. STEWART, I.A.S., whose services have been placed at the disposal of the Government of India for employment as officiating Agricultural Expert to the Imperial Council of Agricultural Research.

On return from leave KHAN BAHADUR MIAN MOHAMMAD AFZAL HUSAIN, M.Sc. (Pb.), M.A. (Cantab.), I.A.S., resumed charge of the office of Entomologist to Government, Punjab, Lyallpur, on the 11th April 1938 and of the Office of Principal, Punjab Agricultural College, Lyallpur, on the 12th April 1938, relieving DR. R. L. CHOPRA, Assistant to the Entomologist and DR. P. E. LANDER, I.A.S., Agricultural Chemist to Government, Punjab, respectively, of the additional charges.

MR. J. S. GAREWAL, M.R.C.V.S., I.V.S., Offg. Director, Civil Veterinary Department, Central Provinces and Berar, has been appointed as Principal and Professor of Medicine, Punjab Veterinary College, Lahore, from the afternoon of the 7th April 1938, relieving MR. W. TAYLOR, M.R.C.V.S., D.V.H., I.V.S., who proceeded on leave preparatory to retirement.

MR. D. P. JOHNSTON, A.R.C.Sc.I., N.D.A., I.A.S., Assistant Director of Agriculture, Punjab, Lahore, has been granted leave on average pay for two months and twenty-eight days and on half average pay for one year, one month and three days with effect from the 31st May 1938.

MR. L. W. SMITH, Superintendent, Government Cattle Farm, Hissar, has been granted leave on average pay for six months and ten days with effect from the 6th April 1938 (afternoon) with permission, as a special case to terminate his contract with Government on the expiry of his leave.

MR. W. S. READ, Assistant Superintendent (Fodder), Government Cattle Farm, Hissar, has been appointed Superintendent, Government Cattle Farm, Hissar, on probation for two years with effect from the 6th April 1938 (afternoon) and will continue to carry on the duties of Assistant Superintendent, Fodder, in addition.

SARDAR KARTAR SINGH, L.Ag., B.Sc. Agri. (Pb.), N.D.D. (Reading), Marketing Officer, Punjab, Lahore, has been appointed Assistant to the Director of Agriculture, Punjab, Lahore, with effect from the 31st May 1938 in addition to his own duties so long as the present marketing scheme remains in force.

Bihar

LT.-COL. C. A. MACLEAN, M.B.E., M.C., M.A., B.Sc., I.A.S., Deputy Director of Agriculture, Tirhut Range, has been appointed to act as Director of Agriculture, Bihar, during the absence, on deputation of MR. D. R. SETHI, I.A.S., or until further orders.

MR. PRABHAS CHANDRA GHOSH, Assistant Director of Agriculture, Sepaya, has been appointed to act as Deputy Director of Agriculture, Tirhut Range, with headquarters at Pusa, in the Bihar Agricultural Service, Class I, *vice* LT.-COL. C. A. MACLEAN, appointed to act as Director of Agriculture, Bihar.

Central Provinces and Berar

The services of Mr. J. S. Garewal, M.R.C.V.S., I.V.S., Officiating Director of Veterinary Services, Central Provinces and Berar, are replaced at the disposal of the Government of the Punjab, with effect from the 29th March 1938 (afternoon).

Mr. Balbir Singh, M.Sc., M.R.C.V.S., Assistant Director of Veterinary Services, Chhattisgarh division, has been granted earned leave for 90 days from the date he avails himself of it.

Mr. M. James, Senior Veterinary Inspector, Yeotmal, has been appointed to officiate as Assistant Director of Veterinary Services, Chhattisgarh division, *vice* Mr. Balbir Singh, granted leave or until further orders.

Sind

Rao Sahib K. I. Thadani, M.Sc. (Tex., U. S. A.), M.Ag., has been confirmed in the appointment of the Director of Agriculture, Sind, with effect from the 15th March 1938.

Burma

Mr. R. Watson, N.D.A., I.A.S., Marketing Officer, Burma, has been granted leave on average pay for five months and in continuation thereof, leave on half average pay for one month and one day, with effect from the 19th May 1938 or the subsequent date on which he avails himself of it.

U Maung Maung, B.A., B.Ag., B.A.S., Class II, Assistant Director of Agriculture, Irrawaddy Circle, Bassein, has been transferred to Rangoon and appointed to hold charge of the duties of the Marketing Officer, Burma, *vice* Mr. R. Watson, I.A.S., proceeding on leave.

U Saw Tun, B.Ag. (Bom.), on promotion to the Burma Agricultural Service, Class I, has been transferred from Meiktila to Mandalay as Deputy Director of Agriculture, Northern Circle.

Dr. L. N. Seth, B.Sc., Ph.D. (Lond.), D.I.C., Burma Agricultural Service, Class II, has been posted as Mycologist, with headquarters at Mandalay.

Recent Publications of the Imperial Agricultural Bureaux

I. OBTAINABLE FROM THE IMPERIAL BUREAU OF SOIL SCIENCE, ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN, HERTS

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	s.	d.
List of publications and papers on Soil Science published in the Empire Overseas in—		
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Soil Research in the British Empire published in 1935	1	0
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Published monthly, per annum, post free	10	0
Monthly Letters—		
Free to recipients, within the British Empire, of "Publications relating to Soils and Fertilisers". Subscription, outside the Empire, per annum	4	0
Recent Developments in Soil Analysis—		
Quarterly Supplement to the above publications. Separate copies, each	0	6

Occasional Papers

	s.	d.
Technical Communications—		
34. Tropical Soils in relation to Tropical Crops	2	6
Annual Report : For the year 1933-34	0	6
" 1934-35	0	6
" 1935-36	0	6
Bibliographies—		
Bibliography on Coffee	2	0
Catalogue of Journals and Periodicals in the Library of Rothamsted Experimental Station	2	0
Special Publication—		
The Katamorphism of Igneous Rocks under Humid Tropical Conditions (by the late Sir J. B. Harrison)	5	0
Bibliography of Soil Science, Fertilizers and General Agronomy, 1931-34 .	25	0

II. OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL HEALTH, VETERINARY RESEARCH LABORATORY, NEW HAW, WEYBRIDGE, SURREY

Abstracting Journal

	s.	d.
The Veterinary Bulletin—		
1931. Vol. 1. Quarterly (1st Number, April)	7	6
Annual subscription	20	0
Subsequent volumes. Monthly (1st Number, January) . . .	5	0
Annual subscription (postage paid)	40	0

		s.	*d.*
	Indexing Publication		
Index Veterinarius.—Four issues a year. First issue, April 1933. Annual subscription (postage paid). Volumes I to III mimeographed, Volume IV onwards printed		100	0

III. Obtainable from the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Bucksburn, Aberdeen

	Journal		
Nutrition Abstracts and Reviews. (Issued under the direction of the Imperial Agricultural Bureaux Council, the Medical Research Council and the Reid Library)—			
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Occasional Communications—			
1. The Effect of Climate on the Composition of Pasture Plants		..	

IV. Obtainable from the Imperial Bureau of Plant Breeding and Genetics, Plant Breeding Institute, School of Agriculture, Cambridge

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Breeding Resistant Varieties, 1930-33 (Supplement)		2	0
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V. Obtainable from the Imperial Bureau of Pastures and Forage Crops, Welsh Plant Breeding Station, Agricultural Buildings, Alexandra Road, Aberystwyth, Wales

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Fruit Growing in the Empire. Standardisation of Horticultural Material with special reference to Rootstocks, 1927. R. G. Hatton. Being unnumbered Empire Marketing Board Publication. (Free).		
Viticultural Research, 1928. D. Akenhead. Being Empire Marketing Board Publication 11	1	0

VII. Obtainable from the Imperial Bureau of Animal Breeding and Genetics, Institute of Animal Genetics, University of Edinburgh, King's Buildings, West Mains Road, Edinburgh

Journal

Animal Breeding Abstracts (quarterly), commencing April, 1933. Annual subscription	15	0

Occasional Papers

Bibliography of the Works of J. C. Ewart (free to subscribers of Animal Breeding Abstracts, Vol. 1), 1934	0	6
Animal Breeding in the British Empire. A Survey of Research and Experiment, 1934	2	0

VIII. Obtainable from the Imperial Bureau of Agricultural Parasitology (Helminthology), Institute of Agricultural Parasitology, Winches Farm Drive, Hatfield Road, St. Albans, Herts

Journal

Bibliography of Helminthology. For the year 1933—		
Library Edition, bound in cloth	10	6
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4. Scientific Monographs of the Imperial Council of Agricultural Research

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9. Miscellaneous

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Errata to *Agriculture and Live-stock in India* Vol. VIII, Part IV July 1938

Page 401, Table I (*a*) *Ratio—straw/grain* Column 5, against 'Treatments' *for* '$0 \cdot \bar{1} \cdot 0785$' *read* '$0 \cdot 0785$' and against 'Error' *for* '$1 \cdot 3957$' *read* '$\bar{1} \cdot 3957$'.

Page 402, Table I (*b*) *Stand*, Heading of column 5, *for* $\frac{1}{2} \log \left[\frac{M.\ S.}{100}\right]$ *read* $\frac{1}{2} \log_e \left[\frac{M.\ S.}{100}\right]$

Page 403, Table I (*c*) *Analysis of variance* (*Unit—$\frac{1}{2}$ oz.*), Heading of column 5 *for* $\frac{1}{2} \log\ (M.\ S.)$ *read* $\frac{1}{2} \log_e\ (M.\ S.)$

Page 403, Table I (*c*) *First picking*, Heading of column 5 *for* $\frac{1}{2} \log \left[\frac{M.\ S.}{100}\right]$ *read* $\frac{1}{2} \log_e \left[\frac{M.\ S.}{100}\right]$

Page 406, 3rd line from the bottom *for* **9** *read* **19.**

Agriculture & Live-stock in India

Vol. VIII, Part VI, November 1938

EDITORIAL

THE SETTLEMENT OF EDUCATED MEN ON THE LAND

In his "Report on the Work of the Imperial Council of Agricultural Research in Applying Science to Crop Production in India." Sir John Russell has referred to the great gap which exists between what could be accomplished by the cultivator in India if he were to utilise fully the knowledge available as a result of agricultural research and what is actually being done by him. For instance, by adopting better methods of cultivation, using improved varieties of seed and protecting their crops from the ravages of diseases and pests, agricultural experimental stations obtain, in the case of most crops, yields vastly greater than those obtained by the average cultivator. But, although such advantages can be gained by utilising present knowledge, the cultivator still continues largely to follow his old methods and adopts the achievements of research only to a limited extent. The great need, therefore, of the present time is to take adequate steps to ensure their wider and fuller adoption.

Sir John considers that one of the greatest handicaps under which Indian agriculture labours in this connection is the absence of an educated agricultural middle class in the village and he contrasts the position here with that in Western countries where he attributes many of the great advances, which have been made, to the shrewdness, and progressive ideas of men of this type. In view of this conclusion, it will be of interest to consider some practical steps which are being taken at present in India to settle educated young men on the land.

Efforts have been made on a small scale in recent years in Mysore and Travancore to place on the land young men who had first obtained some training at an agricultural school. In the former case, progress appears to be slow

so far, whilst in the latter, twenty-four trained boys have been placed on holdings of ten acres each. It is a condition of tenancy that students must live on the land and farm it under the guidance and supervision of officers of the Agricultural Department. A loan up to Rs. 500 is also granted to the student tenant, where required, for the purchase of seeds, manure, implements, etc., and after repayment in full, if all the conditions of the lease have been observed satisfactorily, the land is permanently assigned to him.

By far the largest experiment so far made in placing educated men on the land, is being carried out in the Punjab, where an experimental scheme was started in 1932. In that year, two villages situated in one of the canal irrigated tracts, were colonised entirely by forty-eight educated youths, consisting of forty-four graduates and under-graduates of Arts and Science colleges and four graduates in Agriculture. Each grantee was allotted two squares (fifty-five acres) of canal irrigated land. The principal conditions attached to the lease are :—

(1) The tenant must live permanently on the land and must build on it a residential house to the satisfaction of the local Collector,

(2) The tenant must cultivate the whole of his land with his own hands but he is allowed to employ paid labour to assist him in doing so,

(3) After the expiration of five years, if all the conditions have been observed satisfactorily, the tenant is granted occupancy rights, but he does not obtain proprietory rights,

(4) The tenancies are subject to the rule of primogeniture, but if a tenant dies without having acquired occupancy rights, the tenancy lapses to Government.

During the first two harvests after the commencement of the tenancy Government remitted the whole demand on account of land revenue, *malikana*, occupiers rates and cesses.

In the same year (1932) a considerable number of Agricultural Assistants, many of them possessing some years' experience of departmental work, was brought under reduction, due to financial stringency, and the Punjab Government allotted them similar grants on similar conditions. In this case, however, the grantees were not located in villages set apart for themselves but were scattered in pairs in old colonised villages, where it is expected that by the adoption of the modern methods of farming which they had learnt and which they had been demonstrating to cultivators previously, they will serve as examples for the ordinary cultivators surrounding them of what could be achieved by farming on modern lines.

Again, in 1937, two more villages in canal irrigated areas were completely colonised by forty-one more literate grantees. They consisted of eleven graduates and certificate holders in Agriculture and thirty graduates or undergraduates from Arts and Science colleges. Finally, in the same year also, thirty-eight graduates and certificate holders in Agriculture were allotted

similar grants and, as in the case of the retrenched Agricultural Assistants, were scattered in pairs throughout the older villages.

At present, therefore, 8,910 acres of land in the Punjab have been colonised by 162 educated young men, of whom eighty-nine are the sole cultivators in four villages and the remainder are scattered, usually in pairs, in the older villages. The experiment must continue further before any final conclusions can be reached as to its success or otherwise. A recent visit to some of the grants, however, indicated that ultimate success or failure is likely to depend very greatly on the individuals concerned. There is no doubt whatever that those lessees, who have had an agricultural education, are in a much better position to make a success of their grants than those from Arts and Science colleges and yet some men of the latter class, who have had the foresight to copy the methods employed by their agriculturally trained co-villagers, are producing results which compare very favourably with those of the latter. Even amongst themselves the agriculturally trained graduates vary in their achievements, depending on the extent to which they are prepared to work and to apply the training which they have received. Some of them have been outstandingly successful and in some cases they have actually obtained yields of wheat and cotton which are almost a record and which compare very favourably with the best results which have so far been obtained on agricultural experimental stations in the province

The further progress of this experiment will be watched with considerable interest not only in the Punjab itself but throughout India.

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

XIII. THE CENTRAL PROVINCES CULTIVATOR

2. THE GOND CULTIVATOR

BY

VERRIER ELWIN

THE Gond's attachment to the good earth is illustrated by a story told me by an old peasant in Kawardha State. " God was wondering who should carry on the work of the world. So He made this test. He prepared three chairs, one of gold, one of silver and one of earth. Then He called a Mussalman, a Hindu and a Gond and asked them to choose which they would. The Mussalman sat down in the golden chair, the Hindu took the silver chair, but the Gond chose the earthen chair. Then God said, ' It is the Gond who will carry on the work of the world, for only he who can sit on an earthen chair will be able to bear the hardships that are bound to come. And so God made the Gonds the support and refuge of the world ".

And indeed, out of the three million Gonds scattered across the hills and forests of the Central Provinces and neighbouring States, few have adopted any other profession than that of agriculture. Today, the Gond's methods of cultivation do not greatly differ from those of his more backward neighbours, save that in many places he yokes cows with his bullocks to the plough. In the hills he often has to struggle with poor rocky soil, where only *kodon* and *kutki* can flourish, with oil-seeds like *niger*. After this land is used for three years, it has to be left fallow for an equal period to recoup its fertility. In the plains and valleys, however, the Gond has taken to the regular cultivation of wheat and other cereals. As long ago as 1867, Lawrence said of the Gonds of Bhandara that ' they make good farmers and careful tillers of the soil '. In the last rust and frost years, large quantities of improved wheat seed were distributed on *taccavi* throughout the Province. The Gonds were delighted with this, especially with the A068 wheat, and today in many places which formerly knew nothing but the local *pahari pissi* you may hear Gonds declare that they grow nothing but " Arsath number " (A068 wheat).

But the characteristic type of Gond cultivation, which is still practised by the Maria and Muria Gonds of Bastar, is shifting cultivation. The Gonds and Baigas of the Central Provinces call this *bewar*. In Bastar the system of cutting trees or

Gond cultivator

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Gond cultivator

brushwood and spreading them over a field for burning is called *dahi* in Halbi and *parka* by the Maria Gonds. This system obtains, not on hill-slopes, but on more or less level ground. In Halbi the word *marhan* is applied to shifting cultivation on flat ground : this is called *dippa* by the Muria and Hill Maria Gonds, and *erka* by the Bison-horn Marias. *Penda* cultivation is practised on steep hill-sides. The material to be burnt is roughly distributed over the slope and fired. The Gonds are less passionately attached to this type of cultivation than the Baigas, and under Government pressure have abandoned it almost everywhere.

The cultural life of the Gond is expressed in song and dance, in riddle and legend. A mischievous 'Raj-Gond' movement is attempting to make the Gond despise his old culture ; under its influence he adopts the sacred thread, gives away his pigs and chickens, and abandons the simple and beautiful dances of the past with their richly poetic songs. The reformers who deprive the Gond of meat food do not bother to supply him with vegetable seeds or improved cows which will give him milk and ghee ; and so he becomes thin, sour, emaciated ; an unspeakable drabness overspreads his life. "They have robbed us of our meat, our liquor and our music ; what difference is there now between us and our cattle ? "

But there are still large areas where this evil has not spread. Here the peasant goes to his work with a song on his lips and joy in his heart ; the girls sing their beautiful *dadaria* as they go to pick mangoes in the forest, to weed their fields or to bring water from the well. The old people and the children vie with one another in posing *dhandha* (riddles) by the fire-side. The strength of their agricultural interests may be seen in these songs and riddles.

Wherever the creeper goes, the beans follow—Fish in a river.
The ox is tied in its stall, but the yoke walks away—A creeper.
A little plough wanders fearlessly through the jungle—A razor.

A ploughshare is described as 'a roasted *bami* fish that plunges into the depths' ; a scythe is 'a cow with a crumpled horn that goes into the deepest jungle' ; a lighted lantern is 'a houseful of husks gained from a single grain of rice'. A song written on white paper is aptly described—'Sow black seed in a white field, cut the crop and it awakes and sings'.

The difficulties and joys of farming inform Gond poetry with a realism that keeps it very close to everyday life.

"Sometimes while you are cutting *kodon*,
The stalk slips through your hand, Ho !
The sun is but a bamboo's length above the hills,
And my heart is captured by you "

The life of the fields is never far from romantic love.

"Let us sow *kodon* and *kutki* in one field
Then we will live together all life long."

But it hardships are frequently emphasised.

" He is sowing seed in a hard land
Where the plough breaks and he has to make it new.
He drives the plough and scatters seed,
But there is no harvest of his toil ".

Among all the forms of village welfare that are now so eagerly discussed by politicians, none will benefit the Gond so greatly as agricultural improvement. An army of agricultural *jamadars*, inspired with a missionary spirit, sent into the remoter villages, would do incalculable good. The Gond will not adopt subsidiary village industries ; he is only mildly interested in education ; his villages are already far cleaner and more sanitary than those of civilised people ; but he does not get enough to eat, his crops will barely pay his taxes, they will not clothe his children. No task could be nobler than to improve his harvests.

An old Baiga cultivator of Balaghat

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

XIII. THE CENTRAL PROVINCES CULTIVATOR

3. THE BAIGA CULTIVATOR*

BY

VERRIER ELWIN

THE Baigas are a small tribe, some 40,000 strong, living in Mandla and the neighbouring districts. They are the priests and magicians of all this area. Their charms are indispensable for the recovery of the sick, the success of the hunter, the potency of the bridegroom. They know exactly what secret of fertility to breathe over the reluctant seed. They are the children of Mother Earth, and they live so close to her that she opens to them all her mysteries. The Baiga is no agriculturist, yet he has a profound influence on agriculture. He inspires the Gond and Hindu cultivator with a psychology of confidence and expectation. The peasant has far more confidence in magic than in manure.

The Baiga magicians farm out the countryside into circuits, and continually travel round pursuing their campaign against witches and evil spirits. At the *Bhidri* ceremony of the blessing of the seed at the beginning of the rains, if wild pig and deer destroy the crops, if bullocks stray and refuse to return home, if rust attacks a field, if the rains fail or are too abundant, if tigers molest the watchers in the fields, then the Baiga magician hastens to the rescue. I know even Brahmin landlords who regularly employ Baigas in every agricultural emergency.

The Baigas themselves are passionately and religiously attached to *bewar*, shifting cultivation. Only the severest Government pressure has succeeded in compelling some of them to leave their axes for the plough. *Bewar* was laid upon the Baigas as a right and a duty at the beginning of the world by God Himself, Who forbade them ever to lacerate the breast of Mother Earth with the plough. This is not a mere pious fancy for the Baiga ; it is the pivotal point of his religion. Those Baigas who have taken to the plough are regarded as decadent, traitors to tribal

*An account of the Gonds and Baigas will be found in Russell's "Tribes and Castes of the Central Provinces ". A brilliant description of agricultural ceremonies and superstitions is given by W. V. Grigson in his monumental " The Maria Gonds of Bastar". My own volume on " The Baigas " will be published shortly, and my novels " Phulmat of the Hills " and " A Cloud that's Dragonish " give an account of the lives of Gonds, Patharis and Baigas.

tradition, their magic is weak and beggarly, they are exposed to the attacks of wild animals and the exactions of forest guards. There are still thousands of true Baigas who have never touched a plough. These live in Bilaspur, in the Pandaria Zemindari, in Kawardha and, until recently, in Rewa. A few families remain in the Baiga Chak in Mandla. But no Baiga ploughs with a clear conscience ; fifty years of earnest propaganda has had no real influence on his mind.

The Baigas do nothing haphazard in their *bewars*. A family goes into the jungle and selects a suitable site. When they have found one, they take some rice and throw it over a tree. The head of the family fells it with a single blow of the axe. Then he takes a leaf from the tree, folds it in four, and ties it on the standing stool. This is accepted by other Baigas as evidence of occupation.

A little later, they return and cut all the grasses and brushwood. Fifteen days afterwards, they worship their axes promising Kutki Dai or Anna Dai that if the crop is good, they will make special offerings at harvest-time. They turn the axe with the blade downwards, and recite over it a short *mantra* invoking the aid of Nanga Baiga and Nanga Baigin. Then they go to the *bewar*. Before felling, they offer a coconut to the jungle-dwellers, whose home they are now going to despoil, and then they proceed to fell all the trees within the area chosen, leaving stools about a foot high.

In May they go to burn the now dry wood and undergrowth. In the interval they have distributed the stuff fairly evenly over the *bewar*, but they have carefully observed the original tree that was felled. It is from this that they are to make the Virgin Fire. It is forbidden to kindle the fire with the *chakmak* ; it must be made by twirling a bamboo stick in a hole made in another split bamboo. When the fire has kindled, the bamboos are broken into bits, and each member of the family takes a bit and lights it. They set fire first to the original tree, and then go all over the *bewar* firing it.

The next duty is to fence the *bewar*, which they do with logs and brushwood cut round the edges, and they put snares and traps for deer and other animals.

After the first rain has fallen they take their seed to the *bewar* and perform a variation of the *Bhidri* ceremony, offering special gifts to Dharti Mata. The men fill the folds of their *dhoti* with seeds, all mixed up together—*kodon, kutki, marria, pania, sawar, kang, raseni-kutki, bajri, jowar*—and scatter it anywhere and everywhere in the ashes. After a few days, they return and dibble the lines for *rahar dal* across the middle of the field ; they drop three seeds into each hole. Round the stools of the trees, they sow beans and cucumbers.

At harvest-time, they make a small imitation threshing-floor for Thakur Deo, and offer to him and Anna Dai the first fruits of the crop and a cock or pig, whatever they had promised at the time of felling. It is vital to implement these promises ; there are many grim tales of tigers devouring those who failed to do so.

The first year, the crop is gathered rather than cut ; only the tops of the plants are removed, and the stalks left for next year. The second year, they burn any trees that may be left, and all the dry stalks of the previous harvest. The third year, the crop is generally poor, for there is little left to burn.

They may, however, use the third-year *bewar* as a *dahi* clearing, and drag logs and brushwood from the surrounding forest and spread it over the field.

The Baigas usually thresh their crop without bullocks ; men, women and children go round and round, laughing and singing, and thresh it with their feet.

The Baigas, honest to a fault, witty and charming, lazy, improvident, generous-hearted are some of the most attractive people in the Central Provinces. Although wedded to an out-of-date form of cultivation, they are an important factor in the progress of agriculture in the Province. Agriculture depends not only on seed and soil, monsoon and manure, but on the courage and energy of the human spirit. The Baiga by his magic, by his secret information, by his encouragement, inspires the cultivator to his hard task and helps him to face bravely all the disasters of wind and weather.

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

XIII. THE CENTRAL PROVINCES CULTIVATOR

4. THE BERAR CULTIVATOR

BY

S. G. MUTKEKAR, B.AG., M.SC. (MASS.), I. A. S.

Deputy Director of Agriculture, Berar

THE country known as Berar is a comparatively small province measuring in length about 150 miles and in breadth about 144 miles. It lies approximately in the centre of peninsular India. In extent, it embraces the broad valley running east and west between two tracts of hilly country, the Gawilgarh hills on the north and the Ajanta range on the south. The former, which form a southern offshoot of the Satpura, are known as the Melghat range while the latter is known as the Balaghat range. These two ranges, with the central valley known as the Payanghat or the Purna Valley, form the three main natural divisions of Berar.

Berar is divided into four districts covering an area of 17,767 sq. miles. This area with a total population of 3,441,838 souls gives an average density of 194 per sq. mile. The climate is oppressively hot in the hot season (March to June) ; it varies in the rainy season (June to September) from mild at times of rainfall to oppressive during the breaks in the rains. In October, it again becomes hot and unpleasant. In the cold season (November to February), however, the climate is cool, dry and very agreeable. The average maximum temperature during summer in May is about 108·6°F., while the average minimum during winter in January is 53·1°F. The thermometer, however, frequently rises in summer to 114°F. and occasionally to 117°F. The annual rainfall averages about thirty-two inches with slight variations in each district.

The crops are mostly rainfed, irrigation facilities being very limited. Generally only one crop, either *kharif* or *rabi,* is taken. The most important of the *kharif* crops are cotton and *jowar*, the former being of preponderating importance as a commercial crop. Groundnut is also grown to a certain extent as a *kharif* crop. Wheat, gram, linseed etc. are raised in the *rabi* season over an extensive area in years of good moisture. The total area under crops in Berar amounts to 6,580,474 acres. Of this, about 42 per cent is under cotton, 43 per cent under food crops and the rest is under oil seeds and other miscellaneous crops.

Berar Cultivator

SONS OF THE SOIL

(STUDIES OF THE INDIAN CULTIVATOR)

XIII. THE CENTRAL PROVINCES CULTIVATOR

4. THE BERAR CULTIVATOR

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Berar Cultivator

Of all the crops, cotton is the most popular because of its being a money crop. Further, it is easy and cheap to sow, needs little attention and is easily collected and marketed.

As regards cultivation, the time-honoured methods generally remain unaltered. The cultivator is generally a believer in the wisdom of his forefathers but if he is convinced that a new method or appliance is profitable to him he does not hesitate to adopt it in spite of his conservatism.

The chief cultivating castes in Berar have been the Kunbis, Malis and Baris but at present most other castes have also taken to cultivation and the agricultural industry does not, as in the past, remain confined only to a few communities. The bulk, however, of the cultivators in Berar are Maratha Kunbis. It will only be necessary, therefore, to describe the condition, customs and manners of the Kunbi, who is in excess of all other castes. The distinction between Marathas and Kunbis is almost entirely social. Among the aboriginal tribes that are confined to the hilly tracts, the Korkus form a majority of the cultivating class.

The Berar Kunbi is strong, energetic and hardworking. He is medium in stature, lean and sun-burnt in appearance. He is generally illiterate, simple in habits and kind-hearted. His love for the land that feeds and clothes him is only comparable in intensity to the love of a child for its mother. On its possession is founded his rank, his freedom, his power as a citizen and importance as an inhabitant.

Simplicity in food, dress and manners is the distinctive characteristic of the Berar cultivator. Probably it forms the essence of his life.

Jowar is his staple article of diet. The accessories to *jowar* bread are either boiled pulse (*waran*), boiled and spiced gram-flour (*besan*), ground chillies (*chatni*) or onions (*kanda*). Hence *besan bhakar*, *chatni bhakar* and *kanda bhakar* have become household terms for his meals. Wheat, rice, milk and ghee which form a wealthy man's food are indulged in by the ordinary cultivator only on occasions of festivals and are considered to be luxuries. The custom of using sweet oil on bread is very common and it is very highly relished. As regards vegetables, these are used whenever easily and cheaply obtained. During the rainy season, a variety of vegetation that grows wild either in the fields or on waste lands, provides ample vegetables. During the winter, a few varieties of vegetables are dried in the sun and kept for use during the rest of the year when green vegetables are scarce and costly. Fruit seldom finds a place in the diet except of the rich. Most of the cultivators are vegetarians. In families amongst whom flesh eating is permitted, fish, mutton, fowls and eggs are used occasionally. The women, however, generally do not take non-vegetarian food. Both men and women have the habit of chewing *pan*, betel and sometimes tobacco. During the watching of the *jowar* crop the cultivator is very fond of eating *hoorda* (parched raw grain of *jowar*). Quite a large number of families also keep milking animals but most of the milk

produced is turned into butter and ghee to be sold in the markets. Though not generally addicted to the consumption of intoxicating liquors, the Kunbi likes a drink if it comes his way.

The ordinary dress of a cultivator consists of a *dhoti* (loin cloth), a *bandi* (thick jacket), a shirt, a *pheta* (head dress), a *dupatta* (piece of long cloth which hangs over the head) and a pair of shoes. A coarse blanket serves as a protection against rain and cold. The dress of a woman consists of a *sari*, a *choli* (bodice) and a *wodhani* or *shela*. Corresponding to the blanket used by the men, the women use a *pasodi* which serves both as bedding and protection against cold.

The first thing that strikes a visitor to a village is the lack of any kind of sanitation. The houses have few windows and are built close without sufficient space between them. Further, the cattle sheds are under the same roof and manure heaps containing all sorts of household waste are close to the dwelling house. There are no drains to carry off foul water which accumulates and stagnates in pits dug close to the house.

The household furniture of an ordinary cultivator is very scanty and consists of one or two cots composed of wooden frames interlaced with coir or hemp rope and wooden boxes to keep his clothes and valuables.

The cultivator does not invest his savings, if any, in banks. He will either lend the money or hold it in hidden places. Such savings as he may have, are often utilised for making ornaments. The males usually wear ear and finger rings while the females wear nose-rings, toe-rings, bangles, armlets and necklaces. The total value of the ornaments seldom exceeds Rs. 100.

Due to his keen sense of morality and religious feelings the Kunbi regards marriage as a sacrament rather than a mere contract. Marriage is conducted according to the rules laid down by religion and custom. All girls are married almost without exception either before or immediately after puberty. The boys are married between the ages of fifteen and twenty. Early marriages are not now so common as in the past. Re-marriages are more common among males. The custom of widow-remarriage is not common. Marriage expenses now-a-days are from five to ten times what they were fifty years ago.

The females look after the domestic affairs in the house and help the male members in outside work at times of leisure. They do all the domestic work such as milking, cooking and washing, in the mornings and evenings. During the middle of the day they work in the fields. Amongst the higher class, women confine themselves to household work. The children help their parents as soon as they are seven to eight years old.

The chief festivals of the cultivator are the *Gudipadwa* (*Chaitra*), *Akshya Tritia* (*Vaishakha*), *Pola* (*Shrawan*), *Akharpakh* (*Bhadrapada*), *Dasara* (*Aswin*), *Divali* (*Aswin-kartik*) and *Shimga* (*Falgun*). The total number of days he is off work during the festivals, is about ten. In addition, he spends from fifteen to twenty

days a year in attending religious fairs and marriage ceremonies of relatives and in visiting friends. *Pola* is the biggest festival amongst cultivators who decorate and worship the bullocks and march them in procession all over the village. Everyone tries to show off his bullocks to the best advantage and if these functions are properly organised, they can help in stimulating the interest of the cultivator, in the systematic breeding, feeding and care of his cattle. The cattle in the villages have suffered much from injudicious crossing. Cows are held in reverence but are not properly fed. The people prefer buffalo's milk to cow's milk and take more care of the buffaloes and tend them better. The working bullocks are properly fed and well cared for. Too few young cattle are raised in the village to maintain the supply of bullocks and the stock is continually renewed by purchase.

The Kunbi is not very particular about sending his son to school. He complains that the kind of education that is given in the school does not procure a living and makes the boy unfit for the profession of his father. He says that he would rather keep the boys at home so that they should stick to farm work.

The Kunbi's conception of religion is only the observance of certain fasts, celebrating religious functions and festivals, giving charities and offering prayers. A few of them go for pilgrimages and most of them attend fairs which are generally held in honour of some saint or deity. *Bhajans* (prayers) and *saptahas* (reading stories from religious books) are common at night in many villages.

The Kunbi very seldom indulges in outdoor games. As a matter of fact, an industrious cultivator gets very little time for such recreations. However, on days when work is prohibited, he takes part in village entertainments, such as wrestling matches and *dandhars* (village dramas). He is very fond of *chakra* races which were frequent in the past. Good race bullocks are now scarce but even when available, the cultivators have no money to buy them. Well-to-do cultivators attend dramas and cinemas when they visit urban areas. The most common indoor games are card-playing and singing of ballads.

The Berar cultivator miserably lacks in discipline. Definite planning of work is never done. Purchases of seeds and other agricultural requisites are delayed till the last moment when he often finds that all the seed has been sold or that price has gone up. The hard struggle for existence and the uncertainties of the seasons have made him a fatalist. It is usual for the cultivator to overstep the limits of his resources and to contract debts on special occasions. He shows no hesitation in resorting to litigation in courts even for the most trifling causes. Huge sums of money are spent in litigation and many families which were once considered rich have been ruined in this way. The worst habit of the Berar cultivator is his tendency to borrow without any consideration of his ability to repay. During the years of high prices, he was comparatively rich and prosperous. Instead of paying off his debts, he squandered his easily earned gains in marriages, social functions, entertainments and other extravagancies and as his credit was very good and money

was easily raised, he incurred fresh debts. Thinking that the boom period has come to stay, he purchased high priced lands mostly by borrowed money, hoping to make profits from cultivation. With unfavourable seasons and short crops combined with the fall in produce prices, he now finds himself in difficulties. Being illiterate, he is very easily duped by his creditors. He is fond of display and will spend beyond his means to show his greatness. He is a man of independent spirit and will never tolerate insult or dishonour.

From what has been said about the Berar cultivator, it is evident that all is not well with him. There are signs, however, indicating that he is now in a changing phase. His modes, manners and living are undergoing a rapid change. Education is giving him a wider outlook and his spend-thrift habits are slowly disappearing. He has begun to take interest in his cultivation and is making serious efforts to bring into actual practice the recommendations of the Agricultural Department.

*A SURVEY OF THE COTTON CROP OF HYDERABAD STATE

BY

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INTRODUCTION

HYDERABAD State, also known as "His Exalted Highness the Nizam's Dominions", is one of the chief cotton growing tracts of India. The yearly area under cotton in the State is about fifteen per cent of the total area under this crop in the country. In annual production the State stands fourth amongst all the Provinces, being responsible for nearly ten per cent of the total annual output. The prominence of the State as a cotton producing area is due not only to its large acreage and production of this crop, but also to the excellent quality of an appreciable part of its produce. Hyderabad grows some of the finest indigenous cottons. The variety Hyderabad Gaorani or Bani, well known for the strength and silkiness of its staple, is still grown, in a more or less impure condition, on about a million acres annually in some of the northern and central districts. This variety was formerly the only or the chief variety grown in this tract but during the past thirty years or so, the short-staple more prolific types from Central Provinces and Bombay Presidency have been gradually replacing it in some districts. Even where no such admixture has taken place, the commercial crop is far from pure, having been grown from seed that has been handed down from generation to generation without being purified or improved at any time during its long history. In the south, too, in Raichur and Gulbarga districts, Westerns, Kumpta and Dharwar American varieties are grown on a fairly large scale. But here again a mixture of short-staple types has been slowly taking the place of these varieties during the past fifteen years or more. As a result, it has been very imperfectly known as to how far the original varieties are grown pure or mixed with short-staple types, or how far the crop grown in any district or *taluqa* represents the one or the other, or a mixture of both. Furthermore, though the main varieties of cotton grown in the State have been fairly well known, yet no

* This is a summary of a detailed report which is to be published shortly under the title "Cotton growing in Hyderabad State" as a joint publication of the Indian Central Cotton Committee, Bombay and the Government of H. E. H. the Nizam of Hyderabad and Berar.

detailed information has ever been collected regarding the numerous types existing in them. Even the Indian Cotton Committee of 1919 realised this defect and pointed out in its report that no botanical survey of the cotton grown in Hyderabad had been carried out and that whilst fairly full information was available in regard to the varieties grown, it was impossible to speak with certainty regarding the proportion in which they were found. The Committee also stressed the fact that no botanical work with cotton had been done in Hyderabad till then, and made a number of recommendations for dealing with the cotton problems of the State. Perhaps the most important of such recommendations were the following :—

(1) " A Botanical Survey of the cotton tracts should be carried out in order that the Agricultural Department should be in a position to decide on a definite policy for each tract " and

(2) " Botanical work on Bani on the lines proposed for the British Provinces should be commenced as soon as possible and should be followed with similar work with other varieties ".

With a subsidy from the Indian Central Cotton Committee the botanical work for the improvement of Hyderabad Gaorani was started in May 1929. However, within a few months of the commencement of this work, the Cotton Committee realised the urgent necessity of the botanical survey of the Hyderabad crop and in December 1930 sanctioned funds for the same. The work of survey was started in June 1931 and completed exactly five years after.

OBJECTS

The main objects of the survey of the cotton crop of Hyderabad State were the following :—

(1) To collect and test on a Central Farm the types of cotton growing in the State, and

(2) To determine the proportion of plants of different varieties in the crop of each district.

The collection and study of the existing types was meant to provide material for their systematic improvement and a knowledge of the varietal composition of the crop of each district was needed to enable the Government of Hyderabad to define its policy for each tract. While effort was directed chiefly to the achievement of these principal objects, opportunity was also taken to collect much other useful information regarding agricultural practice in general and cotton cultivation in particular.

METHODS OF WORK

1. *Collection and study of types.*—Typical samples of seed or *kapas* were obtained from a few representative villages of each cotton growing *taluqa* of the

State. The actual number of selected villages depended on the average area under cotton in the *taluqa* concerned and the multiplicity of varieties that the *taluqa* was generally understood to grow. Usually only one sample was obtained from each village but sometimes more than one sample was received. The samples were collected either through the officers of the Revenue and the Agricultural Departments, or directly by sending officials employed on the survey of the crop. Only a few districts were tackled at a time in each year.

These samples were sown separately at the Government Experimental Farm, Parbhani or Rudroor (Nizamabad district), according as they were of *kharif* (autumn harvested) or *rabi* (spring harvested) crop. Each sample occupied three or four long rows, giving a total of 400 to 600 plants. The distance separating adjacent rows was eighteen inches and that between seed-holes was three inches. At the time of flowering, all the plants were labelled for the colour of the flowers and subsequently at the time of harvest each plant was examined in the field for its general habit and the characters of its leaf, boll, lint and seed. On the basis of this examination a representative group of 200 plants in each sample was classified into botanical species and varieties. At the same time, all desirable plants and those representing distinct botanical and agricultural types were labelled. Amongst the last named were included plants showing marked differences of maturation habit, lint-length,-colour, and-feel, and resistance to fungus disease and insect pests. One pound of seed-cotton was picked from each sample and its halo-length, ginning outturn and weight per 100 seeds were determined.

The system of classification adopted for botanical analysis was the one given by Gammie in his memoir on Indian cottons. Although practically all the crops grown from village samples of seed consisted of an amazing assortment of types, yet it was found that a large majority of the plants could be readily assigned to one or other of Gammie's varieties. Only a few plants in each sample did not conform to any one of Gammie's types ; such indeterminable plants were assigned to a class of their own. Since the writing up of the results of this survey, Hutchinson and Ghose of the Institute of Plant Industry, Indore have developed a new classification of Asiatic cottons. The new names are shown in this paper in parenthesis following Gammie's nomenclature.

The vegetative and floral characters of plants labelled as desirable or as representing distinct botanical or agricultural types were recorded. Their produce was harvested separately and was examined for lint and seed characters. A few plants were selected finally for further study and their seed was sown in separate rows in the following season. The resulting progenies were again studied for qualities that characterised the parent selections and flowers of a few typical plants of each true-breeding progeny were self-pollinated. The 'selfed' seed of the progenies that retained the distinctive characters of their parent plants was sown in the succeeding season for maintenance of types.

2. *Botanical analysis of cultivators' crops.*—In addition to the collection and study of typical samples of village seed, the cultivators' crops of a few representative villages of each *taluqa* were inspected and their varietal composition was determined.

The available staff was constituted annually into two batches, each consisting of an Assistant Botanist, two *Kamgars* (fieldmen) and a peon. The villages to be visited by each party were selected in advance and the itineraries of tour were communicated to the revenue officers of the *taluqa* and district concerned. Owing to the heavy rains lasting till the end of September and to the absence of suitable village roads in a greater part of the cotton tract, most of the cotton fields were usually inaccessible up to the middle of October. Accordingly, the inspection of *kharif* crops was done generally in the period from October to December and that of *rabi* crops from February to middle of April.

One to eight representative villages of each *taluqa* were selected for this work. The number of villages actually selected depended on the average cotton area of each *taluqa* and it was generally ascertained beforehand that the selected villages did grow cotton on a fair scale in the season in which they were visited. On arrival at the village, the leader of the party sent for the village-map and crop-records and selected three to ten 'Survey Numbers' or fields (depending on the total number of cotton fields in the village), as representing the standing crop. The selected fields were generally situated in different cardinal directions from the village and belonged to separate cultivators. Each field was then visited by the party and a representative sample of 200 plants, made up of several groups of twenty-five to fifty plants located in the different parts of the field, was classified into botanical species and varieties. Usually this plan worked satisfactorily but in places where plant-growth had remained stunted and the plants did not lend themselves easily to classification, the study of varietal composition was restricted to fields in which the crop had made fair growth, or to those parts of a field where a majority of the plants was in flowers and bolls.

Gammie's system of classification of Indian cottons was used in this botanical analysis. The counts of plants of different varieties existing in the crop of a field were taken on printed forms called "Detailed Survey". The records thus collected were averaged out first for each village, then for each *taluqa* and finally for each district. The mean crop-anlaysis for a village was worked on another printed form. The village forms also had working instructions printed on them. (Specimen copies of these forms can be had on request from the author of this paper.)

At the time of classification of plants in the cultivators' fields, the produce of desirable or distinctive type-plants was secured for subsequent study. The seed of the finally selected plants was sown at the Government Farm and the progenies were studied in the same way as those raised from selections made in the crops that were grown from village-samples of seed.

3. *Gathering of general information.*—Though the study of the varietal composition of cultivators' crops was the chief purpose of visits to representative villages, yet such visits were also utilised for the collection of a mass of other useful information relating to agricultural practices in general and cultivation of cotton in particular. Information was collected, amongst others, on the following subjects :—

(*a*) For each field :—

(*i*) Area under cotton.

(*ii*) Source of sowing seed.

(*iii*) Reasons, if any, for growing the existing variety.

(*iv*) Rotation of crops.

(*v*) Particulars of cultivation, such as time of sowing, pre-sowing cultivation and implements, methods and means of sowing, seed-rate, spacing of plants and rows, interculture, period of harvesting, inter-crop, etc.

(*vi*) Type of soil.

(*vii*) Condition of crop and

(*viii*) Prevalence of diseases and pests.

(*b*) For each village :—

(*i*) Total cultivable area.

(*ii*) Area under cultivation.

(*iii*) Area under cotton and other major crops, respectively.

(*iv*) Nearest cotton market and marketing practices.

(*v*) Means of communication and

(*vi*) Ginning and pressing facilities.

Particulars of agricultural practices were collected by enquiries from intelligent cultivators of the villages themselves, whereas statistics of area were taken from the records maintained by the *patwaries* or village registrars.

Information has also been gathered regarding the following additional subjects :—

(*i*) Area and production of cotton of each *taluqa*.

(*ii*) The total area and production of the State by trade varieties.

(*iii*) Local consumption.

(*iv*) Efforts for the improvement of the crop of each district and

(*v*) Government legislation pertaining to the cultivation and marketing of cotton.

Various published and unpublished records of the Department of Statistics, Agriculture and Commerce and Industries were consulted for this purpose.

Finally, information relating to the spinning properties of the varieties in cultivation in the chief cotton growing districts was compiled from the published and unpublished spinning test reports of the Cotton Committee's Technological Laboratory.

4. *Compilation of meteorological data.*—Tables of monthly rainfall, maximum and minimum temperatures and air-humidity for a number of representative district towns were compiled from the reports of the Government of India Meteorological Department and the Nizamiah Observatory, Hyderabad. The routine records of the Cotton Research Station, Parbhani also were used for this purpose.

Climate and soil

Hyderabad State is situated between 15° 10′ and 20° 40′ N. and 74° 40′ and 81° 35′ E. It is divisible into two distinct but practically equal parts, differing from each other in soil and to some extent in climate. The western half is known as Marhatwadda and the eastern half Telingana.

There are three well defined seasons; a moderately warm wet season from June to September, a cool dry season from October to February and a hot dry season from March to May. In the southern districts of the State there is no real cold season and the hot weather begins early in February.

The mean maximum temperature is 102°—105° F. in April and May, and below 100° in the remaining ten months. The mean minimum temperature rarely falls below fifty degrees. The annual rainfall varies from about eighteen inches in the south-west corner to about forty inches in the north-east. The great bulk of the rain in Marhatwadda districts is received during the south-west monsoon from June to September. In Telingana about three-fourths of the yearly rainfall is caused by the south-west monsoon, and the remainder falls in the early part of the north-east monsoon, *i.e.*, October and November.

The soil of the greater part of Marhatwadda is black cotton soil, or *regur*, formed *in situ* by the disintegration of the underlying Deccan trap, or by the deposit of the alluvium of the rivers coursing in this tract. Karnatak districts, *i.e.*, Gulbarga and Raichur, also have large tracts of *regur* interspersed with fair sized areas of red-coloured, granitic soil. The soil of Telingana is chiefly granitic, and may be coarse or fine grained.

Cultivation of cotton

The vast bulk of the cotton crop of the State is grown as a rain-fed crop, irrigated cotton forming an insignificant portion only.

In Marhatwadda,—including Aurangabad, Parbhani, Nanded, Bhir, Osmanabad and Bidar districts—and a part of Gulbarga district, cotton is sown with the setting in of the south-west monsoon in June and the crop is harvested from October to December or January. In Raichur and southern part of Gulbarga district the crop is sown chiefly in September and harvested from February to April. In Telingana the crop may be sown either in June or in September and harvested from October to December or from March to May. On the average of the five years ending 1934-35, *kharif* cotton occupied 86·9 per cent of the annual cotton area in the State.

The most usual rotation followed in the State is cotton and *jowar* (*Sorghum vulgare* Pers.). *Jowar* may be grown as a *kharif* (autumn harvested) or as a *rabi* (spring harvested) crop. In some parts wheat, gram and linseed take the place of *rabi jowar*, and *bajra* (*Pennisetum typhoideum* Pers.) that of *kharif jowar*. In Karnatak and southern Marhatwadda groundnut is being increasingly grown preceding cotton.

The repeated harrowing of soil with *bakhar* (blade harrow) is the usual means of preparing the soil. The crop is sown in lines except in Warangal, Nalgonda and parts of Bidar and Atraf-i-Balda districts where it is still sown broadcast. The sowing in lines is done with wooden drills, which may be single—, two—, or three-coultered. Paired rows of *tur* (*Cajanus indicus* Spreng.) are planted after every ten or fifteen rows of cotton. Occasionally sesamum, *ambadi* (*Hibiscus cannabinus* Linn.) and *kharif Jowar* are grown mixed with cotton. The crops receive one or two hand-weedings and an equal number of bullock-hoeings. Two or three pickings are taken in the whole season, and the *kapas* (seed-cotton) is picked rather carelessly. A high blow-room loss is characteristic of most of the State's produce. The yield per acre is usually low. The plant-stalks are left standing in the fields for a long time after the last picking and it is not unusual to find them sprouting afresh after the commencement of the new season's rains. The Pink and Spotted Bollworms are the chief insect pests. They cause a loss of about twenty per cent of the annual outturn. *Fusarium* wilt occurs in a few places, but it is not a widespread disease so far.

Area, production and consumption

The total area of the State according to the figures for 1932-33 is 52,926,720 acres. The cultivable area for the same year was 34,102,189 acres and the area actually sown was 30,009,889 acres. Cotton ranks second in acreage among the crops of the State, being excelled by *jowar* only in this respect. The average annual area under cotton for the five years ending 1934-35 was 3,513,903 acres. Marhatwadda is the chief cotton growing tract, being responsible for about eighty-six per cent of the total cotton area of the State. Nearly eighteen per cent of the total cultivated area of Marhatwadda is under cotton. The typically Telingana districts of Nizamabad, Nalgonda, Atraf-i-Balda and Mahbubnagar grow very little cotton.

No marked increase of cotton area is possible in Marhatwadda Division but if the contemplated Purna and Tungabhadra irrigated projects materialise, the area under irrigated cotton will very likely increase. Experiments on *chalka* soils in Telingana indicate that an appreciable extension of cotton growing can be effected in this tract. The canal irrigated Nizamabad district forms another potential area in which good quality cotton may be grown.

Hyderabad State occupies fourth place in the commerical production of cotton in India. The average annual outturn of raw cotton for the period 1931-35 was 486,451 bales of 400 lbs. About ninety per cent of the crop of the State is

grown for export. The vast bulk of the exported produce goes to Bombay Presidency and port. From three-fifths to three-quarters of the local consumption is accounted by the spinning and weaving mills and the balance is made up of cotton used in the villages for domestic purposes or for the production of hand-spun yarn.

Marketing and preparation for export

A large part of the produce is marketed as *kapas* (seed-cotton), only about ten per cent being sold as lint. In some parts of Nanded district a system of forward sales on cash payment (*laoni*) is in vogue. Except the seed required for sowing or feeding cattle, practically all cotton seed is exported.

The unit of weight and the trade allowances vary from market to market. The grower of cotton is rarely able to secure the best possible price for his produce. The Hyderabad Agricultural Markets Act of 1339 Fasli (1929 A.D.) seeks to remove the disabilities and abuses from which the cultivator suffers in the marketing of his crop. Regulated Markets under the Act now exist at Aurangabad, Jalna, Sailu, Hingoli, Nanded, Umri, Latur, Warangal and Raichur. Other markets still remain to be brought under the operation of the Act. The question of prescribing uniform weights and measures for the whole of the State is under the consideration of the Government.

A great bulk of the State's crop is machine-ginned. The total number of factories for handling *kapas* or lint is about 320, most of which are situated at places along the railway line. The factories are not well distributed, so that in several districts *kapas* has still to be carted fifty to sixty miles for ginning. Small establishments are now springing up in villages in the interior.

The watering of cotton, mixing of different varieties and false-packing of bales—malpractices which were common a few years ago—have been stopped by the Government by framing rules, under the Hyderabad Factories Act, for the licensing of ginning and pressing factories.

Commercial varieties and protected areas

The cotton crop of Hyderabad State consists of four trade varieties namely, Hyderabad Oomras, Hyderabad Gaorani, Kumpta and Coconadas.

Hyderabad Oomras includes the produce of Aurangabad, Parbhani, Nizamabad, Karimnagar, Medak and Mahbubnagar, and parts of Adilabad, Osmanabad and Bhir districts. It also includes the *mungari* (early sown) crop of Gulbarga and Raichur districts. It is a white to dull white, short-staple, coarse cotton, ginning 32-34 per cent and spinning 8-12's warp counts. Its annual area and production are 2,100,000 acres and 204,000 bales.

Hyderabad Gaorani is the produce of Nanded and Bidar districts and the adjoining parts of Adilabad, Bhir and Osmanabad. It is a creamy white, leafy, medium-staple, fine cotton, ginning 25-28 per cent and spinning 24-30's warp counts. It sells generally at an appreciable premium over the contract rate for

Broach. Its annual area and production are about 900,000 acres and 128,000 bales.

Kumpta includes the *hingari* (late sown) crop of the Raichur and Gulbarga districts. It is a creamy white, medium-staple, fairly fine cotton, ginning 25-27 per cent and spinning 20-24's warp counts. Its annual area and production are 424,000 acres and 50,000 bales.

Coconadas is grown in Nalgonda district and the southern part of Warangal district. It is a brown to dark brown, medium-staple, fairly fine cotton, ginning 23-25 per cent and spinning 16-20's warp counts. Its annual area and production are 33,000 acres and 3,500 bales.

The geographical distribution of commercial varieties is shown in Fig. 1 and their botanical composition in Appendix I.

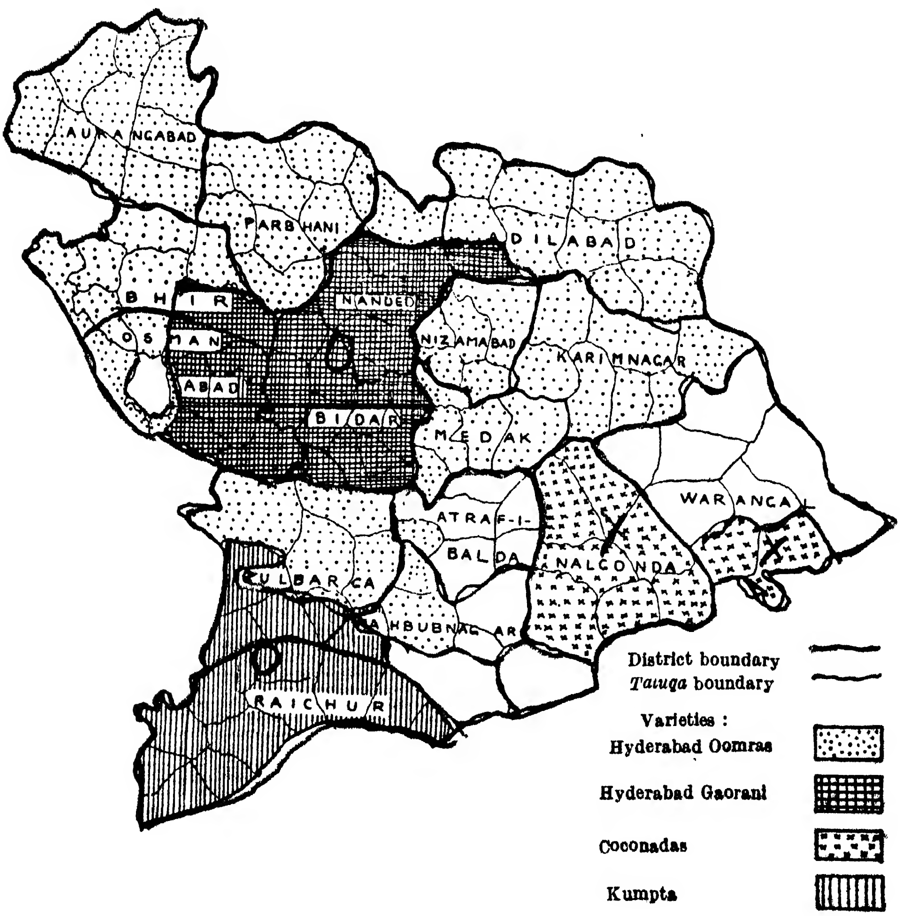

Fig. 1. Map of Hyderabad State showing geographical distribution of commercial varieties of cotton

The tract growing Gaorani cotton and the western part of Raichur district are protected areas under the Hyderabad Cotton Cultivation and Transport Act of 1929. The annual distribution of large quantities of Gaorani seed of known origin, the prohibition of the import of seed of short-staple varieties, and the separate handling of medium-and short-staple produce in markets and ginning factories have helped to restore the reputation of Gaorani cotton. The Raichur Protected Area grows almost pure crops of Jaywant and improved Dharwar-American on a fairly large scale. Pure seed of the two varieties is distributed in this area every year.

Botanical composition

The present day crop of the State is composed principally of the following botanical types, grown mixed or almost pure :—

(*a*) *Gossypium indicum* Lamk. (*Gossypium arboreum* L. var. *neglectum* Watt forma *indica* H. & G.)

(*b*) *Gossypium neglectum* Tod. var. *rosea* (*Gossypium arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G.)

(*c*) *Gossypium neglectum* Tod. var. *cutchica*. (*Gossypium arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G.)

(*d*) *Gossypium neglectum* Tod. var. *malvensis*. (*Gossypium arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G.)

(*e*) *Gossypium neglectum* Tod. var. *vera*. (*Gossypium arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G.)

(*f*) *Gossypium hirsutum* Mill. (*Gossypium hirsutum* L.)

(*g*) *Gossypium herbaceum* Linn. (*Gossypium herbaceum* L. var. *frutescens* Delile.)

(*h*) *Gossypium obtusifolium* Roxb. var. *Coconada*. (*Gossypium arboreum* L. var. *typicum* H. & G. forma *indica* H. & G.).

The proportion of these types varies from district to district and often times in different parts of the same district. The average compostion of the crop of each district is given in Table I. For districts growing both *kharif* and *rabi* cotton, varietal analyses of the autumn and spring harvested crops are given separately. The percentage occurrence of the two major types *G. neglectum* Todaro. (*G. arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G.) and *G. indicum* Lamk. (*G. arboreum* L. var. *neglectum* Watt forma *indica* H. & G.) in the different parts of the State is shown in Fig. 2. The areas showing a more or less common range of occurrence of a given type are linked by means of, what may be called for want of a better name, "Varietal Lines".

TABLE I

Average botanical composition of the commercial crop of each district of Hyderabad State

Districts	Crop season	Varietal Composition (per cent)										
		G. indicum Lamk. (*G. arboreum* L. var. *neglectum* Watt forma *indica* H. & G.)	*G. neglectum* Tod. (*G. arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G.)					*G. hirsutum* Mill (*G. hirsutum* L.)	*G. herbaceum* L. (*G. herbaceum* L. var. *frutescens* Delile)	*G. obtusifolium* Roxb. var. *Coconada.* (*G. arboreum* L. var. *typicum* H. & G. forma *indica* H. & G.)	*Banilla* (*G. arboreum* L. var. *neglectum* Watt)	Other types
			Var. *rosea*	Var. *cutchica*	Var. *vera*	Var. *malvensis*	Total					
1	2	3	4	5	6	7	8	9	10	11	12	13
Aurangabad	*Kharif*	11·0	52·0	7·9	8·9	6·3	75·1	12·5	...	...	1·3	0·1
Parbhani	Ditto	24·8	43·6	5·2	6·5	2·2	57·5	17·1	...	...	0·2	0·4
Bhir	Ditto	27·0	38·0	9·8	5·4	4·4	57·6	15·3	...	...	Trace	0·1
Nanded	Ditto	69·6	4·1	1·0	0·2	0·3	5·6	24·8	...	...	Trace	...
Osmanabad	Ditto	60·4	8·8	0·8	0·1	0·1	9·8	29·8	...	...	...	...
Bidar	Ditto	55·0	0·5	0·2	0·1	Trace	0·8	44·2	...	...	...	Trace
Gulbarga	Ditto	44·0	2·1	39·0	0·6	1·6	43·3	10·0	2·1	...	...	0·6
	Rabi	2·8	1·0	3·3	0·7	0·4	5·4	0·6	89·2	...	...	2·0
Raichur	*Kharif*	21·0	13·2	48·1	4·9	3·3	69·5	0·5	8·8	...	...	0·2
	Rabi	0·3	0·1	0·5	Trace	Trace	0·6	7·5	91·3	0·2	...	0·1
Karimnagar	*Kharif*	70·4	3·4	8·4	11·2	3·8	26·8	0·5	2·3	...	...	...
	Rabi	0·2	...	...	0·1	...	0·1	...	99·6	...	...	0·1
Adilabad	*Kharif*	38·1	53·6	3·0	1·5	1·4	59·5	2·3	Trace	...	...	0·1
	Rabi	32·2*	0·1	Trace	Trace	0·1	0·2	Trace	67·5	...	...	0·1
Nizamabad	*Kharif*	71·3	24·0	0·7	1·0	1·2	26·9	1·8	...	...	...	Trace
	Rabi	0·2	...	...	...	...	...	...	99·7	...	...	0·1
Nalgonda	*Kharif*	6·5	...	...	...	...	..	...	...	93·5	...	...
	Rabi	1·6	Trace	...	...	...	...	...	...	97·7	...	0·7
Medak	*Kharif*	90·2	...	...	1·4	1·9	3·3	6·0	...	...	...	0·5
Warangal	Ditto	92·1	0·1	1·0	Trace	0·6	1·7	4·3	0·8	0·9	...	0·2
	Rabi	4·3	Trace	...	Trace	...	Trace	0·4	22·9	72·4	...	Trace
Atraf-i-Balda	*Kharif*	75·4	0·1	0·2	3·0	1·5	4·8	19·8	...	...	...	Trace
Mahbubnagar	Ditto	8·9	7·4	57·4	4·1	7·4	76·3	0·7	12·2	...	...	1·9
	Rabi	4·5	0·5	1·5	0·4	0·1	2·5	1·3	89·8	...	...	1·9

*The higher percentage of *G. indicum* in the *rabi* crop of Adilabad district is due to the cultivation of a late maturing type of this cotton on a fairly large area in the cold season.

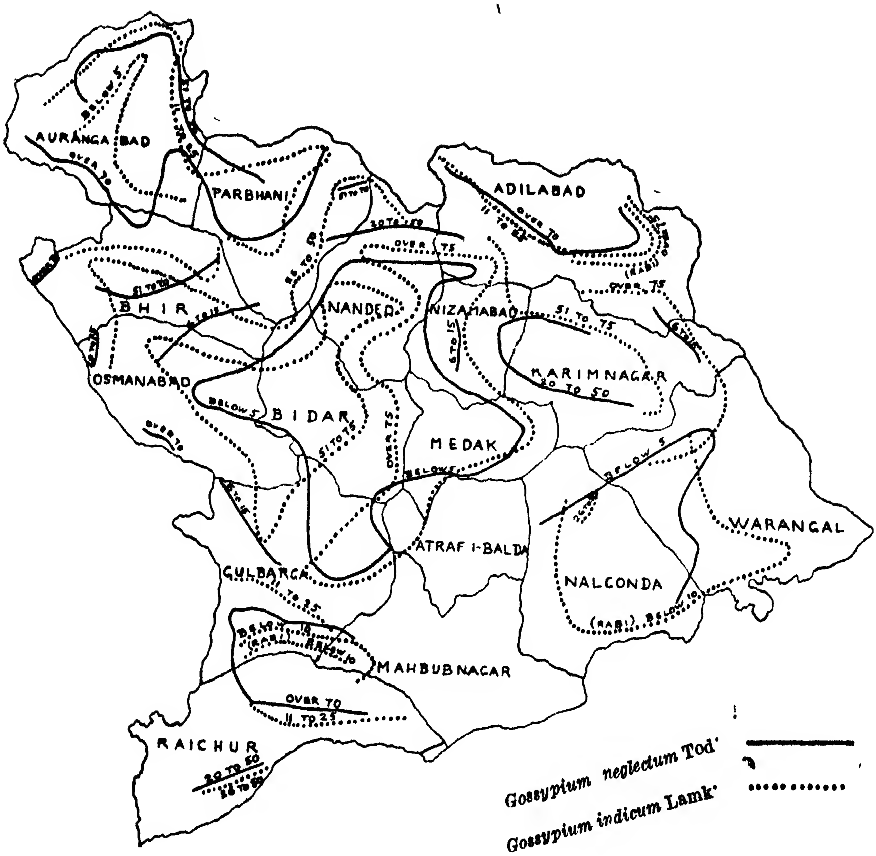

Fig. 2. Map of Hyderabad State showing percentage occurrence of *Gossypium neglectum* Tod. (*Gossypium arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G.)

and

Gossypium indicum Lamk. (*Gossypium arboreum* L. var. *neglectum* Watt forma *indica* H. & G.)

The high relative occurrence of a botanical type in a particular area may be due to its inherent suitability to the conditions of soil and climate obtaining therein, or to extraneous causes such as a special demand for its produce. Although much further investigation is necessary for the determination of factors actually responsible for high survival in each particular instance, yet the study of the geographical distribution of the botanical types in the State and observations made in the cultivators' crops as well as on the true-breeding types isolated and grown at the Government Farm, give the following interesting indications :—

(1) The distribution of *G. neglectum* Tod. (*G. arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G.) shows that it is not an indigenous type but is an introduction from Berar and Bombay Presidency.

The *neglectum* varieties are generally quick maturing and they seem well suited to areas where rains cease early and the annual rainfall is not heavy. The higher survival of *cutchica* (*G. arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G.) in Karnatak districts seems to be due to its ability to produce a good crop in a very short growing season and to withstand scarcity of rainfall.

(2) The north-eastern part of Marhatwadda seems to be one of the tracts in which *Gossypium indicum* (*G. arboreum* L. var. *neglectum* Watt forma *indica* H. & G.) is indigenous. This species seems specially suited to well-drained, fertile black soils of a moderate depth, and subject to an assured rainfall. However, its existing distribution in the State appears to be due more to the fostering care of both the Government and the trade than to any inherent superiority over other types in suitability to its environments.

(3) The *herbaceum* (*G. herbaceum* L. var. *frutescens* Delile) plant of Raichur and Gulbarga is quick-maturing, short-statured and compact, having very few or no vegetative branches. It is akin to the plant of the same variety as grown in the adjoining parts of Bombay and Madras Presidencies. The *herbaceum* plant of the northern districts has a somewhat bushy appearance but is otherwise similar to its southern confrere.

(4) *G. obtusifolium* Roxb. var. *Coconada* (*G. arboreum* L. var. *typicum* H. & G. forma *indica* H. & G.) appears well-suited to light black sandy soils in areas that receive the benefit of both the south-west and north-east monsoons. In the absence of frost it can be grown as a *kharif* crop as well as a *rabi* crop.

(5) *G. hirsutum* Mill (*G. hirsutum* L.) grows equally well on highly retentive, black soil of great depth and on well-drained shallow soil of a lighter description in hilly areas in the north where the annual rainfall is comparatively heavy.

Fairly comprehensive information is now available regarding cotton growing in Hyderabad. This information will enable the State Government to decide on a well considered and co-ordinated policy for the improvement of the several types of cotton at present in commercial cultivation. A collection of true-breeding botanical and agricultural types has also been built up and these types can be used as a nucleus for further improvement work.

ACKNOWLEDGMENTS

I am indebted to the Government of H. E. H. the Nizam of Hyderabad and Berar and the Indian Central Cotton Committee of Bombay who jointly financed the work of survey of the Hyderabad Cottons. My thanks are also due to my assistants Messrs. B. B. Mulchandani, N. R. Yardi and M. A. Jaleel who rendered valuable help all through this work.

Appendix I

Botanical composition of the commercial varieties of cotton of Hyderabad State

Trade name	Botanical composition
Hyderabad Oomras .	Mixture of different types of *Gossypium arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G. with a small proportion of *Gossypium arboreum* L. var. *neglectum* Watt forma *indica* H. & G. and *Gossypium hirsutum* L.
Hyderabad Gaorani .	Mixture of *Gossypium arboreum* L. var. *neglectum* Watt forma *indica* H. & G. with *Gossypium hirsutum* L. the former constituting 70-80 per cent. Sometimes a sprinkling of *Gossypium arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G. also occurs.
Kumpta . . .	*Gossypium herbaceum* L. var. *frutescens* Delile with a small proportion of *Gossypium hirsutum* L. and a trace of *Gossypium arboreum* L. var. *neglectum* Watt forma *bengalensis* H. & G.
Coconadas . . .	*Gossypium arboreum* L. var. *typicum* H. & G. forma *indica* H. & G.

EXPERIMENTS ON THE MANUFACTURE OF CASEIN UNDER INDIAN CONDITIONS

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Introduction

Casein is the principle protein of milk, occurring as a calcium compound and forming in cow's milk, approximately 3 per cent of the whole. It belongs to the complex group of phospho-proteins. Although it had played an important part in the human dietary from time immemorial, in the form of cheese and other edible products, it has entered only recently into the commercial spheres of its ut l sation.

Casein is manufactured from separated milk and Rogers *et al* [1935], Scherer [1921], and Fisk [1923], report that it is lrgely employed in the manufacture of paper, glue, paints, textiles, medicinal foods, polishes, face creams, etc.

Casein manufacture in India dates back to 1911. It was first made in the dairy districts of Gujrat with the advent of the cream separator and then spread to other milk producing centres in Bombay Presidency, United Provinces, Bengal and Madras. Even today it is made in a crude manner and its quality is not up to the desired standard.

Figures for the total output of casein in this country are not available, but the export of home-made casein (Table IV) indicates a steady rise in production since 1932-33. It can be seen from the table that the export of Indian casein is quite intensive throughout the world and that it has increased from 7,805 cwts. valued at Rs. 72,283 in 1932-33 to 12,577 cwts. valued at Rs. 3,32,667 in 1936-37. At present it is estimated that Gujrat alone produces nearly fifty tons of casein per month, and supplies about ten tons per month for use in India.

Kothavalla [1928] describes the present crude methods of the manufacture of casein in Gujrat. The study reported herein was undertaken with a view to improve these processes and with the hope that the results might benefit both the manufacturer and the consumer of casein.

Experimental

Three kinds of casein were experimented upon, *viz.*, (1) Rennet casein, (2) Lactic casein and (3) Acid casein. In all cases, fresh separated cow's milk was used. The processes studied are discussed below. Determinations made and data obtained are treated under the following headings :—

(1) Composition.

(2) Binding capacity.

(3) Solubility.

(4) Yield.

(5) Colour.

1. Rennet casein.—Forty lbs. of separated milk was placed in a double jacketed vat. The temperature of milk was raised to 86°F. and liquid rennet extract of known quality was added at the rate of 1¾ ozs. to 100 lbs. of separated milk. The coagulam was allowed to set for thirty-five minutes to obtain the desired firmness for breaking. It was then broken up with a wire knife to the size of small ¼″ cubes and heated to temperatures between 125°F. and 145°F. for thirty minutes. Throughout this period it was stirred with a cheese rake. The whey was drawn off and the crude casein was washed with cold and warm water alternately, as indicated in Table II. The wet casein was then put in a press and given 500 lbs. pressure per square inch for four minutes to expel the free moisture as far as possible. It was then mashed through a wire screen of twelve meshes per inch to render it granular and facilitate drying. The granula casein was spread evenly in a thin layer over a special type of drying rack which permitted free circulation of air from all sides and assisted in quicker and cleaner drying, and was dried in the sun for four to five hours under the seasonal conditions prevailing at Bangalore during June and July.

The results of this experiment (Tables I and II) show that heating to 135°F. for thirty minutes and washing with water in the order cold, warm, warm and warm yielded the most satisfactory product ; less water was required for washing, the moisture content of the finished casein was low, the colour was a fair white and the binding capacity was good.

2. Lactic casein.—The Lactic casein or that made from naturally soured milk is mostly used for technical purposes. Forty lbs. of separated milk was put into the vat and the temperature was raised to 96°F. at the time of inoculation. Eight pounds of starter with an acidity of ·8 per cent was used per 100 lbs. of separated milk for complete coagulation in twenty-four hours, after which the curd was broken up with an ordinary knife and allowed to remain for three hours for the separation of the whey. After the removal of the whey the curd was washed as shown in Table III. The curd was then put under pressure mashed,

and dried in the sun the same as rennet casein. The moisture content in the green curd was higher than that of rennet and acid caseins.

The finished casein was fairly white in colour like that of " light ivory ".

The washings of lactic curd were found to be less effective in removing the fat and bringing good colour to the finished casein.

3. *Acid casein.*—Since the precipitation of casein from milk occurs completely at pH 4·6 to 4·8 the experiment was conducted to prepare casein of good appearance, from fresh separated milk by using dilute hydrochloric acid (1 in 8). The curd formed was allowed to settle in the vat and the whey was drawn off in two equal portions ; the second portion after again adjusting the acidity to pH 4·6 to 4·8 with the dilute hydrochloric acid.

The curd washed with water acidified hydrochloric acid of pH 4·6 to 4·8. The green curd was put under pressure, smashed and dried in the sun in the same manner as other caseins.

The acid casein took less time for mashing than the lactic casein but more than the rennet casein. The moisture content of the green curd was higher than the rennet casein but lower than that of the lactic casein.

The final product in each of the methods was in granular form.

Composition.—The average analysis of six samples of the experimental casein compared with Gujrat casein is as follows :—

	Rennet casein	Lactic casein	Acid casein	Gujrat casein
Ash . . .	7·50 per cent	1·64 per cent	2·34 per cent	1·52 per cent
Moisture . . .	9·00 ,,	7·20 ,,	8·20 ,,	10·80 ,,
True protein nitrogen	12·00 ,,	11·27 ,,	12·06 ,,	11·76 ,,
Fat	0·21 ,,	0·80 ,,	0·40 ,,	1·10 ,,
Phosphorus . .	0·68 ,,	0·65 ,,	0·69 ,,	0·67 ,,
Sulphur . . .	0·59 ,,	0·58 ,,	0·62 ,,	0·58 ,,

The ashing was done in an electric muffle furnace. The rennet casein showed a higher ash content compared to other caseins.

The true protein nitrogen was determined by the Kjeldahl method after treating the casein with Stutzer's reagent.

The fat content in the finished casein was determined by Werner-Schmidt method [Bray and Major, 1923].

The phosphorus was estimated by the Plimmer and Bayliss method.

The sulphur content was determined by Carius's method.

The ash content varies slightly with the thoroughness of the washing, but depends chiefly upon the method of the precipitation. The fat content decreases

slightly with thorough washing but depends more upon the efficiency of cream separator. The size of granules has considerable effect on the drying time, moisture content, and the colour of casein. The granules sieved through twelve meshes per inch were found suitable under the drying conditions mentioned in the experiment.

Binding capacity.—To find the binding capacity of the prepared casein, glues were made from several samples. The glues were prepared by dissolving a known weight of casein in a known volume of sodium hydroxide and distilled water. The glues were applied to standard wood blocks with a surface of four sqr. inches, and tested for their binding capacity. Glue from rennet casein withstood 2,040 lbs. pressure while the acid and lactic caseins withstood 900 lbs. and 790 lbs. pressure respectively compared to Gujrat casein which withstood a pressure of 780 lbs.

Solubility.—All the varieties of casein were tested for their solubility using (1) hydrochloric acid, (*ii*) sodium hydroxide and (*iii*) borax :—

(*i*) Hydrochloric acid (1 in 10).

	Amount of H cl.	Casein	Temperature	Time	Remarks
Rennet casein .	20 c. c.	3 grms.	70°C.	Six minutes	Insoluble
Acid ,, .	Ditto	Ditto	Ditto	Ditto	Partly soluble
Lactic ,,	Ditto	Ditto	Ditto	Four minutes	Completely soluble

(*ii*) Sodium hydroxide N/10.

	Amount of NaoH	Casein	Temperature	Time	Remarks
Rennet casein .	20 c. c.	3 grms.	70°C.	Two minutes	Completely soluble
Acid ,, .	Ditto	Ditto	Ditto	Less than two minutes	Ditto
Lactic ,, .	Ditto	Ditto	Ditto	Less than a minute	Ditto

(*iii*) Borax ·5 grms. dissolved in 10 c. c. of water :

Lactic casein, soluble in less than three minutes.

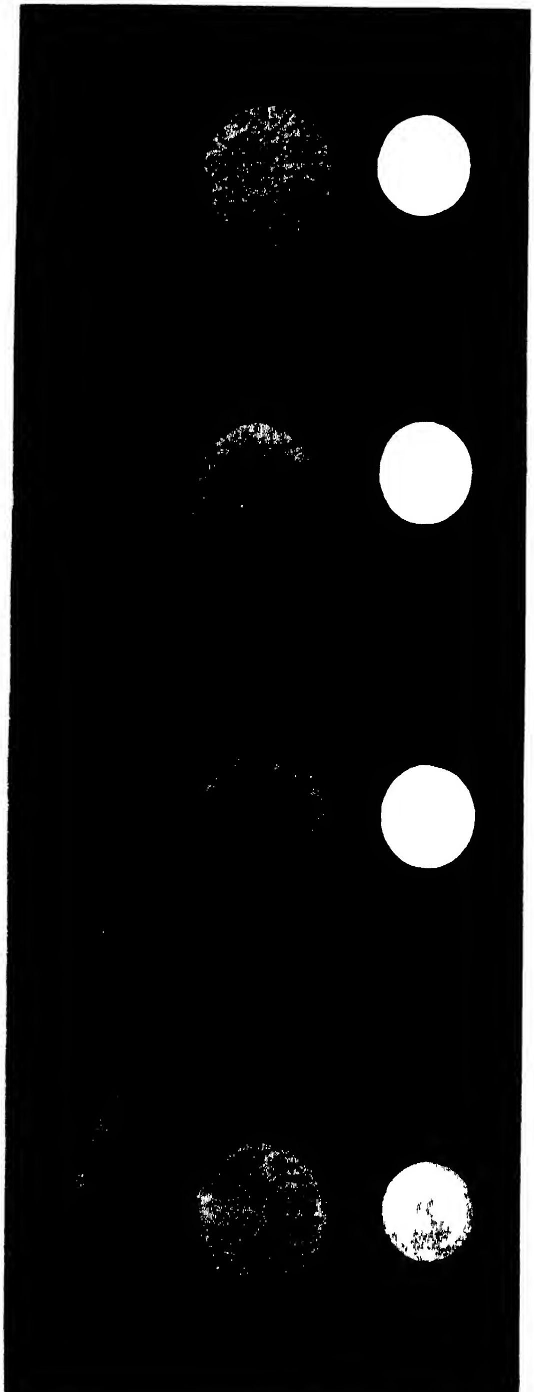
Acid casein partly soluble.

Rennet casein insoluble.

(*iv*) *Yield.*—The following yield was found in the experiment :—

Rennet casein gave an outturn of 2·9 per cent

Acid	,,	,,	,,	3·3	,,
Lactic	,,	,,	,,	2·6	,,


Rennet casein
Lactic casein
Acid casein
Gujrat casein
Fair white
Light ivory
Bright white
Cream

It would not be out of place to say that to make casein manufacture more remunerative, its byproduct, whey, which is now being entirely wasted in this country, should be subjected to a better use. Whey is a nutritious food and it may be used for the manufacture of whey powder or milk-sugar with advantage. This aspect of casein manufacture should receive serious consideration as the current practice of allowing it to run into the drain not only renders the surroundings unhealthy but entails considerable economic loss to the casein industry.

Colour.—The colour of the different caseins obtained is indicated in Plate XLIV along with the size of the casein grains.

Summary

(1) A good quality of rennet casein of white colour was made by washing the curd three times with warm water and once with cold, and drying in sun.

(2) Lactic casein of fair quality and light ivory colour was made, but the quality and colour of the casein could not be improved by washing the soft green curd.

(3) A good quality of acid casein of bright white colour was made by precipitating it from separated milk at pH 4·6 to 4·8, washing with wash water of the same pH value, and drying it in the sun.

Acknowledgment

We wish to express our thanks to Messrs. Zal R. Kothavalla, Imperial Dairy Expert, and H. C. Verma for their guidance in our work and the judging of the samples of finished casein.

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Table I

Rennet casein

Rennet was added at 86°F. and cooking time was thirty minutes at the various temperatures

Lot No.	Cooking temperature	Moisture content of the green curd	Condition of the day, time for drying with the relative humidity	Quality of casein	
				Colour	Moisture content
		Per cent			Per cent
1	120°F.	52·30	4 hours in bright sun R. H.—62 per cent	Inferior ivory .	12·30
2	125°F.	51·20	Ditto .	Ditto .	12·30
3	130°F.	50·10	Ditto .	Ditto .	12·30
4	135°F.	44·90	4 hours in bright sun R. H.—55 per cent	Good white .	7·70
5	145°F.	41·86	Ditto .	Inferior ivory .	9·71

TABLE II

Rennet casein

Cooking temperature, 135°F; time for cooking, thirty minutes; quantity of water, 5 lbs. for each washing for every pound of green curd

Lot No.	Number of washings	Temperature of washing waters	Moisture content of the green curd	Condition under which dried; relative humidity	Time for drying	Colour and moisture content of the casein
			Per cent		Hours	
1	4	Cold . . 70°F. Warm . . 120°F. Cold . . 70°F. Cold . . 70°F.	44·90	Bright sun; R. H.—55 per cent.	Four .	White; 8·70 per cent
2	5	Cold . . 70°F. Warm . 120°F. Cold . . 90°F. Warm . . 120°F. Cold . . 90°F.	50·61	Bright sun; R. H.—62 per cent	Ditto .	Inferior white; 9·81 per cent
3	6	Cold . . 70°F. Warm . . 120°F. Cold . . 90°F. Warm . . 120°F. Cold . . 90°F. Cold . . 90°F.	50·50	Bright sun; R. H.—62 per cent	Ditto .	White; 9·80 per cent
4	6	Cold . 70°F. Warm . . 120°F. Cold . . 90°F. Warm . . 120°F. Warm . . 120°F. Cold . 90°F.	45·80	Bright sun; R. H.—55 per cent	Ditto .	Inferior white; 9·50 per cent

TABLE II—*contd.*

Lot No.	Number of washings	Temperature of washing waters	Moisture content of the green curd	Condition under which dried ; relative humidity	Time for drying	Colour and moisture content of the casein
			Per cent		Hours	
5	6	Cold . . 70°F. Warm . . 120°F. Cold . . 90°F. Warm . . 120°F. Warm . . 120°F. Cold . . 90°F.	45·81	Bright sun ; R. H.—62 per cent	Five .	Inferior white ; 8·86 per cent
6	6	Cold . . 70°F. Warm . . 120°F. Cold . . 90°F. Warm . . 120°F. Cold . . 90°F. Cold . . 90°F.	50·62	Bright sun ; R. H.—62 per cent	Ditto .	Inferior white ; 8·68 per cent
7	5	Cold . . 70°F. Warm . . 120°F. Cold . . 90°F. Warm . . 120°F. Cold . . 90°F.	48·0	Bright sun ; R. H.—58 per cent	Ditto .	Inferior white ; 8·67 per cent
8	4	Cold . . 70°F. Warm . . 120°F. Warm . . 120°F. Cold . . 90°F.	49·81	Bright sun ; R. H.—54 per cent	Ditto .	Inferior white ; 8·62 per cent
9	4	Cold . . 70°F. Warm . . 120°F. Warm . . 110°F. Warm . . 110°F.	45·0	Bright sun ; R. H.—58 per cent	Ditto .	Bright white in colour ; 8·15 per cent

TABLE III

Lactic casein

Curd coagulated for twenty-four hours. Amount of starter used, 10 per cent at ·84 to ·98 per cent of acidity

Lot No.	Number of washings with temperature of wash water	Moisture content of the green curd	Condition under which dried with relative humidity	Casein: Colour	Casein: Moisture content	Casein: Fat content	Casein: Ash content
		Per cent			Per cent	Per cent	Per cent
1	3 cold . . 85°F.	63·3	48 hours—cloudy; R. H.—78 per cent	Light ivory	7·2	0·31	1·54
2	2 cold . . 85°F. 1 warm . . 105°F.	60·3	Ditto .	Ditto .	7·4	0·26	1·74
3	2 cold . . 85°F. 1 warm . . 105°F.	60·3	Ditto .	Ditto .	7·2	0·29	1·63
4	1 warm . . 105°F.	60·3	Ditto .	Ditto .	7·50	0·40	1·65
5	1 warm . . 105°F. followed by a stream of cold water—85°F.	52·20	Ditto .	Ditto .	7·3	0·50	1·64

TABLE IV

Exports of casein from Bombay by sea to foreign countries during the official year ending 31st March 1933 to 1937 *

Countries	1932-33		1933-34		1934-35		1935-36		1936-37	
	Cwts.	Rs.	Cwts.	Rs.	Cwts.	Rs.	Cwts.	Rs.	Cwts.	Rs.
United Kingdom	5,187	47,833	1,444	33,028	44	1,060	340	6,600	700	17,000
France	80	1,200	..	..	..	..	..	..	..	..
Belgium	43	850	40	1,077	..	..	210	4,100	..	..
Netherlands	594	5,500	..	..	787	15,750	200	4,000	185	7,550
Sweden	..	..	..	..	200	4,000	..	..	834	26,500
Germany	1,901	16,900	6,705	1,21,075	6,739	1,30,760	9,569	1,85,562	8,724	2,23,852
Italy	..	..	..	..	100	1,800	..	..	..	..
U. S. A. *via* Atlantic Coast.	..	..	..	..	..	..	..	..	400	11,500
Japan	..	..	..	..	..	..	1,114	23,860	1,583	39,903
Federated Malaya States.	..	..	..	..	60	1,575	..	..	112	4,922
Palestine	..	..	..	..	..	..	..	..	39	1,440
Other countries	..	..	20	350	22	596	19	450	..	..
Total	7,805	72,283	8,209	1,55,530	7,952	1,55,541	11,452	1,24,572	12,577	3,32,667

* (By the courtesy of the Chamber of Commerce, Bombay.)

THE ROTATION OF TOBACCO FOR THE PREVENTION OF WILT DISEASE IN PIGEON-PEAS [*CAJANUS CAJAN* (LINN.) MILLSP.] *

BY

R. D. BOSE

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I. Introduction

Rotation of crops is one of the ways in which the agriculturist can combat the insect pests and fungal diseases which often prevent him from obtaining the best results from the land at his disposal. The success or failure of a crop generally is dependent upon its reaction to a particular pathogen. The employment of soil disinfection as a measure of controlling plant diseases by means of chemicals applied directly, is not possible because of the huge cost it would involve. The rotation of crops on the other hand is by no means a difficult measure to adopt for keeping down infections as each plant pathogen often has specialised requirements of its own and does not usually increase in the absence of a suitable host. The purpose of this paper is to show that the rotation of the tobacco crop with pigeon-peas tends to check to some extent the incidence of wilt in the latter crop.

Extensive studies have been conducted at the Imperial Agricultural Research Institute at Pusa on the wilt disease of pigeon-peas and types resistant to this disease have been isolated [McRae and Shaw, 1933 and Annual Reports of the Institute since 1923-24]. It has been shown that the causal organism of the disease (*Fusarium vasinfectum* Atk.) lives in the soil and is capable of attacking the host plant throughout the whole life cycle of the latter, and that different types of pigeon-peas react differently to the ravages of this fungus. Thus the eighty-six types of pigeon-peas evolved at Pusa [Shaw *et al*, 1933] differ widely in their susceptibility to wilt, ranging from extremely susceptible types, such as Pusa Types 5 and 15, to highly resistant forms like Pusa Types 51 and 80. This can be illustrated by the behaviour of some types in 1931-32 in a field which

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had a high degree of natural infection [McRae and Shaw, 1933]. There were about 1,200 plants in each type and the loss due to wilt was recorded as follows :—

Type	Loss due to wilt per cent
15	45·0
16	7·2
24	14·0
51	1·7
64	10·9
69	50·7
82	2·6

The wilt-resistance experiments with pigeon-peas conducted at the Botanical Section, Pusa, from 1925-26 onwards were mostly carried out in fields where an artificial epidemic of the disease had been created. For this purpose the fields were infected by burying pieces of diseased stems of pigeon-peas uniformly in the soil between the host plants, when the latter were about three to four weeks old. Under these conditions it was found that Pusa Type 5 and some others were highly susceptible to wilt, while Types 80, 82, etc., were more or less resistant to this disease. The percentage loss of plants due to wilt in Types 5 and 80 under such artificially infested field conditions was observed in different years to be as follows :—

TABLE 1

Percentage loss of pigeon-pea plants due to wilt

Year	Field	Percentage loss in	
		Type 5 per cent	Type 80 per cent
1927-28	Barah 7	88·0	2·3
	Barah 8	100·0	9·6
1928-29	Barah 7	98·7	7·3
1929-30	Barah 8	99·0	47·9
1930-31	Barah 6	74·3	0·9

TABLE 1—*contd.*

Percentage loss of pigeon-pea plants due to wilt

Year	Field	Percentage loss in	
		Type 5 per cent	Type 80 per cent
1931-32	Barah 6 . .	86·0	3·0
	Barah 8 . .	95·0	60·0
1932-33	Barah 7 . .	97·3	18·6
	Lawn 1 . .	95·2	0·8
	Lawn 2 . .	95·5	2·0
1933-34	Barah 6 . .	39·0	4·5
	Lawn 1 . .	91·2	2·5
	Lawn 2 . .	100·0	..
	Lawn 3 . .	91·3	14·0

It was evident, therefore, that under the conditions of the experiment, Pusa Type 80 showed a high degree of resistance except when sown in the field which had been under pigeon-peas for several years, when a loss in the resistance was inevitable. The loss of 47·9 and 60·0 per cent in Type 80 in Barah 8 in 1929-30 and 1931-32 respectively has been brought about by growing pigeon-peas very frequently in this plot under infested conditions. Such loss in resistance is not transmitted to the next generation. On the other hand, Pusa Type 5 showed very high susceptibility, the percentage loss of plants ranging from 74·3 in 1930-31 to 100 per cent in 1927-28. In 1933-34, however, the loss due to wilt in one field, Barah 6, was only 39 per cent whereas in Lawn Plot 2, that very year, it was as high as 100·0 per cent. Other conditions being identical the cause of this fall in mortality in this particular year in Barah 6 could be assigned only to the fact that the field had been under tobacco in the previous season and the after effects of the tobacco crop were such as to retard the normal growth and development of the wilt fungus. This toxic condition appeared not only to bring about a fall in the mortality of the host plants but also helped a great deal in retarding the time taken by the fungus to attack them. Fig. 1 shows the mortality of pigeon-pea plants in 1931-32 in Barah 6 when the field was artificially infested with wilt spore material for the first time, as well as in Barah 8 in which the wilt experiment had been conducted for a number of years. It is apparent that the distribution of deaths due to wilt was more or less similar in the two fields.

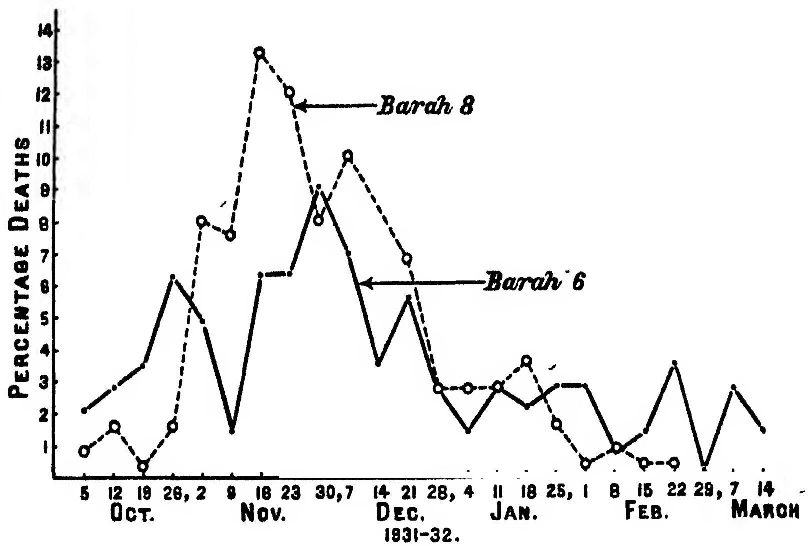


FIG. 1. Mortality of pigeon-pea plants in 1931-32 in Barah 6 and Barah 8 plots

Fig. 2, on the other hand, brings out very clearly the fact that the intensity as well as the rate of mortality in Barah 6 in 1933-34 were greatly retarded, whereas the death rate, etc., in Lawn plots 1, 2 and 3 were high and were more or less of the same order. It may be remarked that identical conditions and the same wilt spore material or inoculum for infection were given to all the four fields under consideration.

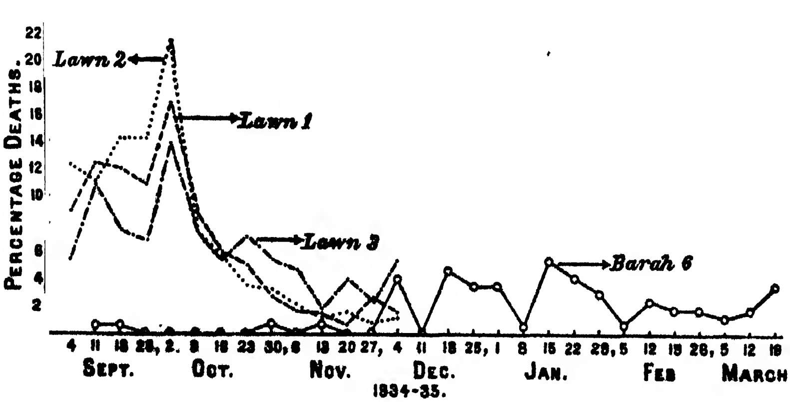
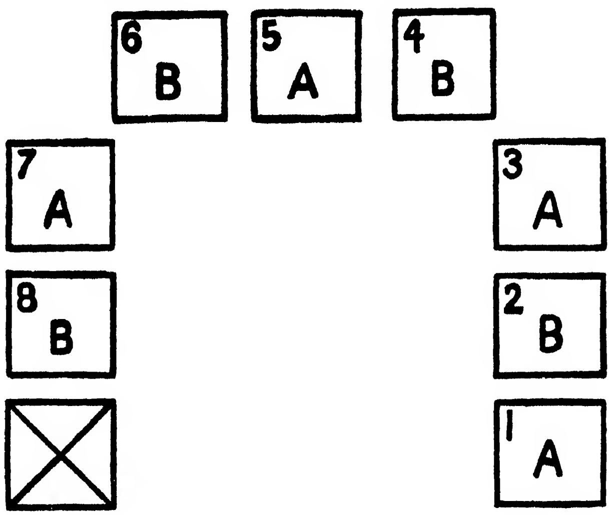


FIG. 2. Mortality of Pigeon-pea plants in 1933-34 in Barah 6 and Lawn plots 1, 2 and 3

The differential response shown by the development of the fungus as well as its ability to attack the host plant only to a limited extent, and that too after a great length of time, showed that some retarding factor or factors were operating in Barah plot 6. To further elucidate this point the experiments described in this paper were undertaken.

II. Material and method

Eight lysimeters were utilized for the experiment. About three feet of soil was dug out from each of these lysimeters in May 1934 and replaced by alluvial soil either from a field which was under tobacco in the previous season or from an adjacent field which had linseed in the preceding year. Lysimeters numbered 2, 4, 6 and 8 were filled with tobacco soil and 1, 3, 5 and 7 had soil from the linseed field as is shown in Fig. 3.



Treatment A = Soil from linseed field.

Treatment B = Soil from tobacco field.

Fig. 3. Showing relative position and number of lysimeters

Pieces of tobacco stems were buried in lysimeters having tobacco soil in them. Equal quantities of linseed stalks were also applied to the lysimeters containing linseed soil in order to maintain an uniformity of the humus-content of the soil in the two series of lysimeters.

The same lysimeters were also utilised in 1935-36 and 1936-37. Every year they received a fresh infection with diseased stem pieces but were maintained without any further change. Seed of a susceptible type of pigeon-pea, *viz.*, Pusa Type 5 was sown in all the lysimeters in all the three years, somewhere

in the second or third week of July. The soil was infested in every lysimeter by burying pieces of diseased pigeon-pea stems in the soil, six inches apart between the rows, usually three weeks after sowing. The artificial epidemic thus provided by the infected material was severe, as is reflected by the almost cent per cent deaths that occurred in the host plants.

Hydrogen-ion concentration.—In 1934 small samples of soil were collected up to a depth of one foot from different parts of each lysimeter on August 10th, and were sent to the Imperial Agricultural Chemist for the determination of their *p*H values. The author is indebted to this officer for his kind help in this connection. The values obtained through his courtesy are given in Table I.

TABLE I.

Lysimeter No.	*p*H value in lysimeter with	
	Linseed soil	Tobacco soil
1	8·28	
2		8·17
3	8·28	
4 . . .		8·32
5	8·32	
6 . . .		8·32
7	8·23	
8		8·28
Mean *p*H value . .	8·2775	8·2725
Standard error . .	±0·0189	±0·0354

Mean difference in *p*H value=0·0050 and the Standard error of mean difference= ±0·0399.

The difference, therefore, is not significant and it may safely be concluded that the *p*H values in the soil under both the treatments are identical and cannot account for the differences in the incidence of wilt in the two sets of lysimeters. This fact corroborates the findings of McRae and Shaw [1933] who had also estimated the hydrogen-ion concentration in the permanent manurial plots at Pusa during one complete season, in three inch layers of soil down to a depth of two feet. They obtained *p*H values ranging from 7·3 to 8·3 and mentioned that the fungus grows well at all these concentrations on culture media.

III. Experimental results

Mortality of plants due to wilt

A weekly count of the number of plants that were definitely attacked by wilt was started four weeks after sowing but the data presented in Table II have been summarized on a monthly basis for convenience and clearness. Four-weekly intervals have been considered to represent each month ; *viz.*, weeks 1 to 4, 5 to 8, 9 to 12 have been grouped to represent respectively the first, second and third months after sowing. Plants in which more than half the branches showed wilting due to *Fusarium vasinfectum* Atk. were included in each count and were cut and removed from the lysimeters. Wilted plants were very carefully examined and only those which were definitely identified to be suffering from the attack of *Fusarium* were included in the count. Table II shows the distribution of the percentage of wilted plants per month in the two series of lysimeters. It may be pointed out that the number of plants in each lysimeter was only fifty in 1934-35 and the plants that year were well-spaced. The germination was cent per cent and there were no casualties due to causes other than wilt. In the following two years, however, seeds were sown closer to each other, there being about 160 seedlings per lysimeter.

TABLE II

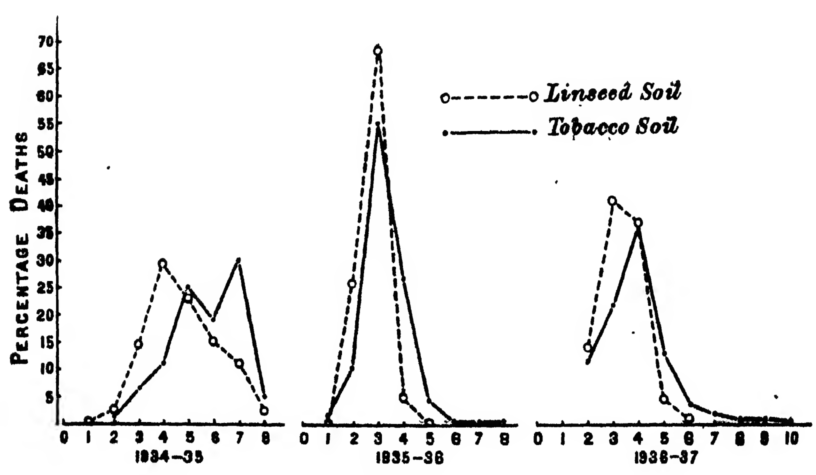
Percentage of deaths due to wilt in pigeon-pea plants sown in lysimeters at Pusa

Year	Nature of soil	Lysimeter No.	Percentage of wilted plants per month: Months 1	2	3	4	5	6	7	8	9	10	Total percentage of deaths due to wilt	Average time*	Standard deviation
1934-35 . .	Tobacco soil . .	2	...	2·0	16·3	22·4	28·8	8·2	20·3	2·0	...	...	100·0		
		4	...	4·2	8·2	18·4	24·3	24·6	20·3	...	...	...	100·0		
		6	...	...	...	4·4	11·0	26·2	50·0	6·5	...	...	98·1		
		8	...	...	2·2	...	36·9	17·5	30·5	12·9	...	...	100·0		
		Mean	...	1·55	6·67	11·30	25·25	19·12	30·27	5·35	...	...	99·51	5·67	1·31
	Linseed soil . .	1	...	2·0	10·2	32·8	30·5	16·3	8·2	...	...	...	100·0		
		3	...	2·1	25·0	14·6	18·6	18·8	10·5	10·4	...	...	100·0		
		5	2·0	4·0	12·0	48·0	24·0	6·0	4·0	...	...	...	100·0		
		7	...	2·3	15·5	22·6	20·5	20·5	22·6	...	...	...	100·0		
		Mean	0·50	2·60	14·68	29·50	23·40	15·40	11·32	2·60	...	...	100·0	4·77	1·41
1935-36 . .	Tobacco soil . .	2	2·9	15·3	53·6	24·6	2·2	0·7	...	...	...	...	100·0		
		4	3·5	12·6	53·8	25·2	4·2	0·7	...	...	...	...	100·0		
		6	...	7·7	61·2	25·1	3·9	0·7	0·7	0·7	...	...	100·0		
		8	...	6·5	53·2	32·4	7·9	...	...	...	...	...	100·0		
		Mean	1·60	10·58	55·45	26·83	4·52	0·53	0·18	0·18	...	...	100·0	3·25	0·88

	Linseed soil . .	1	...	26·5	70·7	2·8	...	...	...	...	..	...	100·0		
		3	...	30·8	62·9	5·7	0·6	...	...	...	...	...	100·0		
		5	1·3	23·2	68·5	6·4	0·6	...	...	...	...	...	100·0		
		7	...	23·1	71·3	5·6	...	...	...	...	...	...	100·0		
		Mean	0·30	25·90	68·40	5·10	0·30	..	...	...	...	...	100·0	2·79	0·60
1936-37 . .	Tobacco soil . .	2	...	11·2	18 9	38·3	15 6	3·9	1 9	...	0·6	0·6	91·0		
		4	...	11·1	16 0	35·9	1f 6	5·6	4·2	0·7	1·4	1·3	91·5		
		6	...	10·9	26·4	40·6	7·8	1·9	1·2	2·6	0·6	...	93·3		
		8	...	13·7	26·2	31·0	12·4	3·5	1·4	0·7	1·4	...	90·3		
		Mean	...	11·73	21·88	36·45	13·10	3·72	2·18	1·00	1·00	0·47	91·5	3·93	1·20
	Linseed soil . .	1	...	10·1	38·7	45·6	4·4	...	...	...	...	...	98·8		
		3	...	23·0	51·0	21·1	3·4	0·7	...	...	...	...	99·2		
		5	...	14·1	44·2	46·7	3·2	...	...	...	...	...	98·2		
		7	...	10·2	30·6	44·4	8·4	4·2	...	...	...	...	97·8		
		Mean	...	14·35	41·12	36·95	4·85	1·23	...	...	...	...	98·5	3·37	0·82

* Average in months of the time taken by the plants to die of wilt.

Owing to heavy infection provided to each lysimeter every year and the very susceptible nature of the seed used for the experiment, the mortality of plants has invariably been very high, being 99·51 and 100·0 per cent in 1934-35, 100·0 and 100·0 per cent in 1935-36 and 91·5 and 98·5 per cent in 1936-37 in the tobacco and the linseed soil series respectively. The most striking feature, however, is that in all the three years, deaths due to wilt took place earlier in the season in the linseed soil series of lysimeters and were retarded for a longer period in the tobacco soil series. The averages, calculated in monthly units of the distributions of deaths due to wilt, are invariably statistically higher in the lysimeters containing tobacco soil, indicating that the time taken by the plants in these soils to die has always been longer than in lysimeters containing soil from a linseed field. The fact is also evident from the distributions of deaths shown in Fig. 4. There are therefore strong indications that the tobacco soil has a retarding effect on wilt and thus even under the severest conditions of soil infestation, mortality of the host plant has been delayed here.



Months after sowing

FIG. 4. Distributions showing the average percentage of deaths in pigeon-peas due to wilt in lysimeters containing soil from tobacco and linseed fields respectively

In 1935-36 there was a heavy precipitation of rain during August and September and hence the wilt fungus developed and spread earlier in the soil. Wilting of plants, therefore, started and completed itself earlier in both the series of lysimeters. In spite of the adverse conditions of high mortality in the earlier months, occasioned by severe artificial infection and heavy rainfall, enough evidence is present to indicate that the rotation of tobacco exerted an influence on the incidence of wilt.

The distributions of deaths due to wilt in the two series of lysimeters are again well differentiated in 1936-37, the third year of the experiment. It may be pointed out that the general conditions of growth and vigour of the pigeon-pea crop remained better in the tobacco series than in the linseed series. Thus on 14th September 1935 the diameters of the stems of twenty young plants in each lysimeter were measured at a level of one foot from the soil surface and showed that the plants in the tobacco soil were on the average thicker than those in the linseed soil. The measurements obtained were :—

(1) Average diameter of plants in tobacco soils . $6 \cdot 67 \pm 0 \cdot 28$ mm.

(2) Average diameter of plants in linseed soils . $5 \cdot 77 \pm 0 \cdot 22$ mm.

Mean difference . $= 0 \cdot 90$ mm.

Standard error of the difference . $= \pm 0 \cdot 36$ mm.

Therefore, the difference is statistically significant, indicating greater thickness of plants in tobacco soil.

Weed control.—In the lysimeters containing soil from a tobacco field and in which tobacco stumps had also been buried the growth of weeds was greatly checked. The lysimeters having soil from a linseed field, on the other hand, had to be weeded out frequently. A marked difference in the amount of weeds in the two series of lysimeters was noticeable during the first two years of the experiment. The writer is of the opinion that the toxic effect of the previous tobacco crop as well as that of the stumps buried in the soil possibly helped in keeping down the weeds in the lysimeters in the tobacco series. Thus apart from its value as a disinfectant for soil borne fungi such as *Fusarium vasinfectum* Atk., the rotation of the tobacco crop and the practice of burying stumps of tobacco in the soil appears to help in controlling weeds in the succeeding crops.

In order to further test the hypothesis put forward in the preceding pages a fresh field experiment was laid out in 1936-37. A diagrammatic sketch of the lay-out of the field is given below :—

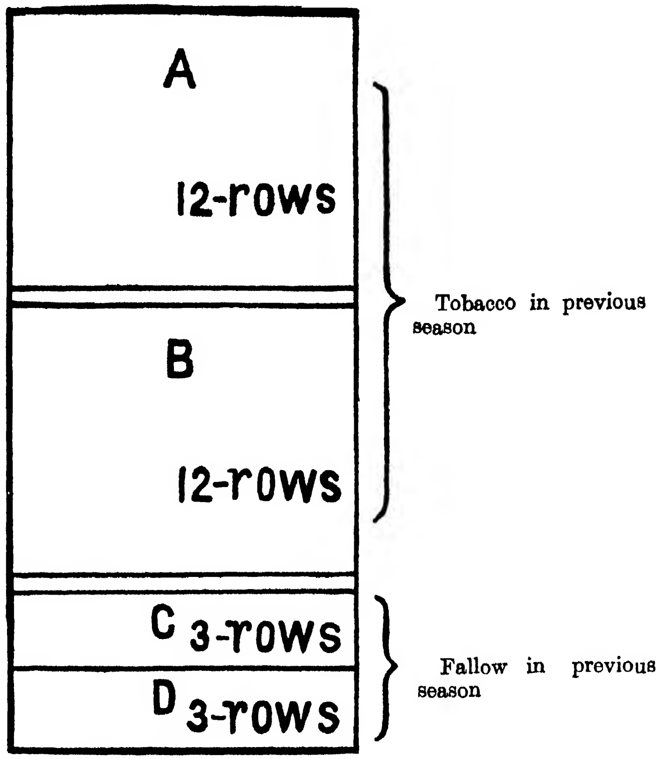


FIG. 5. Diagrammatic representation of the lay-out of pigeon-pea type 5 in orchard B plot in 1936-37

The seed was dibbled by hand at intervals of six inches and the rows were 2½ feet apart. There were twelve rows each under treatments A and B, but for want of space in this particular field only three rows each could be accommodated under treatments C and D. Each row contained approximately thirty plants. Plots B and C were artificially infested with wilted material on July 20th, whereas plots A and D were not infected at all and are to be considered as check plots. Plots A and B were 15 feet by 30 feet in size, whereas plots C and D were 15 feet by 8 feet each. Details of the distribution of deaths due to wilt in this experiment are presented in Table III.

It will be noticed that the total percentage of wilted plants in plot A which contained tobacco soil and was not infested was only 34·60 per cent and that deaths of more than 5 per cent per month were observed in the seventh to the ninth months (figures italicized). Plot B, on the other hand, which was also

TABLE III

Distribution of the percentage of deaths due to wilt in pigeon-pea plants, sown in a small plot, Orchard B, at Pusa in 1936-37

Plot	Nature of soil	Wilt infestation	Percentage of wilted plants per month — Months 1	2	3	4	5	6	7	8	9	10	Total percentage of deaths due to wilt	*Average time	Standard deviation	Yield of seed from surviving plants
																lbs.
A	Tobacco soil .	Non-infected .	...	...	...	0·29	2·64	3·52	*7·62*	*5·87*	*10·26*	4·40	34·60	7·86±0·25	1·49±0·13	106
B	Ditto .	Infected . .	...	0·26	1·03	*5·17*	*9·30*	*17·84*	*13·96*	*10·86*	*8·53*	3·10	70·05	6·71±0·18	1·65±0·14	53
C	Fallow soil .	Ditto .	...	1·19	2·38	4·76	*35·74*	*29·79*	*15·48*	1·19	4·76	...	95·29	5·74±0·13	1·26±0·09	2
D	Ditto .	Non-infected .	...	...	...	1·22	*20·74*	*19·52*	*18·30*	*8·54*	*8·54*	1·22	78·03	6 55±0·15	1·32±0·11	17

N.B.—Deaths of more than 5 per cent per month are italicized
* Average in months of the time taken by the plant to die of wilt.

SUMMARY OF RESULTS

Plots	Mean difference	Standard error of difference	Ratio of mean difference to standard error of difference
A—B	1·15	0·308	3·73
A—C	2·12	0·282	7·52
A—D	1·31	0·292	4·49
B—C	0·97	0·222	4·37
B—D	0·16	0·234	0·68
D—C	0·81	0·198	4·08

under tobacco in the previous season but which was artificially infested with wilt, showed 70·05 per cent mortality due to this disease and the distribution of deaths extended from the second to the tenth months after sowing. Deaths of more than 5 per cent per month occurred from the fourth to the ninth months in this plot. The other two plots, C and D, were lying fallow in the previous cropping season. The former was infested with wilt and showed 95·29 per cent of deaths with the distribution of deaths ranging from the second to the ninth months and the highest number of deaths taking place in the fifth, sixth and seventh months in the order mentioned. Plot D which was the non-infested control showed a total death percentage of 78·08 and deaths of more than 5 per cent per month taking place here from the fifth to the ninth months. The differences between percentage deaths due to wilt in the tobacco soil and the fallow soil are statistically significant.

Comparing the average differences of the distributions in different plots it is found that the deceased plants in plot A have taken significantly longer time to die than in plots B, C and D. Similarly, the deceased plants in plots B and D took a longer time to die than those in plot C, whereas those in the last named plot died sooner and in greater numbers than plants in any other plot. Statistically the difference in the average time taken for the plants to die in plots B and D, *viz*., the difference between $6·71 \pm 0·18$ months and $6·55 \pm 0·15$ months respectively is not significant. The ratios of mean differences to their respective standard errors are shown at the bottom of Table III.

The results are very clear and show the value of the rotation of the tobacco crop for the prevention, to some extent, of wilt disease in pigeon-peas, especially in the early stages of growth.

A graphical representation of the distributions of deaths in the four treatments is shown in Fig. 6.

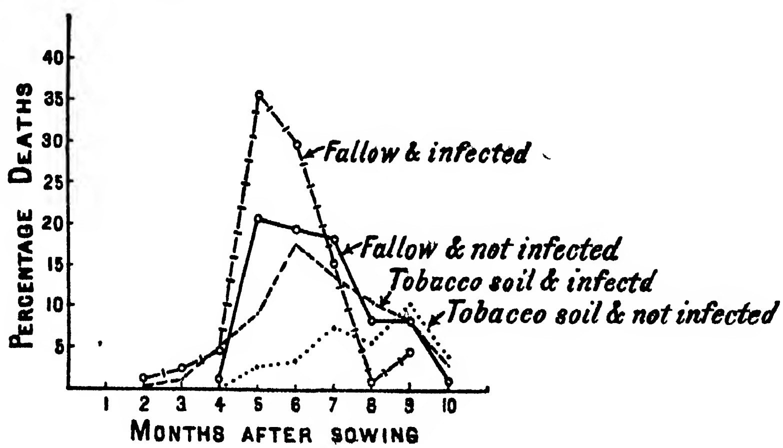


FIG. 6. Distributions showing the average percentage of deaths due to wilt in pigeon-pea in a field experiment in 1936-37

The yields of seed from the surviving plants of pigeon-peas from each of the sub-plots are presented in the last column of Table III. The yield has been maximum in the non-infected tobacco soil plot due to the least amount of mortality and healthier growth of plants in this plot.

IV. Summary and conclusions

Proper crop rotation not only gives rest to the land and maintains the equilibrium of the soil-constituents present but also restricts to some extent the spread and development of many fungal diseases and insect pests which are thereby deprived of their normal growth in the absence of their particular hosts. Thus the ravages of Orobanche (*tokra*) in Solanaceous crops such as tobacco, tomatoes, brinjals, etc., can be minimized by proper rotation by growing such crops in the same field only after a number of years.

Indications were obtained at Pusa in 1933-34 that the severity of wilt (*Fusarium vasinfectum* Atk.) attack in pigeon-peas (*rahar*) may be mitigated if the crop was grown in fields which had been under tobacco in the preceding season. This observation has been further substantiated by the experiments detailed in this paper.

A set of four lysimeters filled with alluvial soil from a tobacco field and another set filled with similar soil from an adjacent linseed field were taken in 1934-35 and kept on without disturbance throughout the course of the experiment. Pusa *rahar* Type 5, which is very susceptible to wilt was sown for three consecutive years in all the lysimeters and the latter were infected every year artificially with *Fusarium* spore material Weekly observations of the number of plants that died due to wilt during the period were maintained from the fourth week onwards. Due to the severity of the infection deaths due to wilt were invariably very high, but it was found that the time taken by plants in the tobacco soil series to die of wilt was significantly longer than that taken by plants grown on linseed soil.

The results of a field experiment conducted in 1936-37 confirmed in a striking manner those of the above quoted experiments and showed that the rotation of tobacco with pigeon-peas retards the growth of the pathogen and thus enables the host plants to escape the ravages of the disease to a considerable extent. This was true even in that part of the field where an artificial epidemic of the disease was created by wilt infestation.

The hydrogen-ion concentration of the soil in all the lysimeters was determined in 1934 and was observed to be identical in the two series of lysimeters. The humus content of the soil in both the series was also maintained more or less on an equal basis. Other conditions being identical, it is surmised that the tobacco stumps and buried roots were responsible for checking the growth of the wilt fungus and for retarding the attack of wilt on the host plant for a longer period.

It is, therefore, advocated that in addition to the use of resistant varieties of pigeon-peas, tobacco should be grown in rotation at intervals of about three or four years, in fields where pigeon-peas are usually raised. This rotation should especially be practised in areas, such as parts of North Bihar, where wilt takes a heavy toll from the pigeon-pea crop. In low lying lands, where the cultivation of tobacco would appear unprofitable, it may be enough to obtain pieces of tobacco stems from other fields and to bury these in the soil a month or more prior to the sowing of pigeon-peas. The importance of this practice can well be realised from the experiments reported in this paper. The cost involved is very nominal but the premium obtained in saving a large percentage of plants from the attack of wilt would by no means be inadequate.

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ZOOLOGY IN RELATION TO VETERINARY SCIENCE *

BY

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HISTORICAL

A STUDY of the nineteenth century veterinary literature shows that the veterinarians of that time concentrated their attention upon the diseases and treatment of horses only. It was not until 1828 that the horizon of veterinary science widened to embrace the anatomy and diseases of other domesticated animals, like cattle, sheep, swine, dogs, etc. Since those days, great have been the improvements in veterinary education. Nowadays, a fairly high standard of preliminary basic education, almost equal to that demanded for any other learned profession, is required of prospective students ; the courses of study have been progressively lengthened to three, four and five years ; the scope of the subjects taught has increased ; the sciences of Biology, Physics, Chemistry, Anatomy, Physiology, Pathology, Hygiene, Genetics, Therapeutics, Medicine, Surgery, Milk and Meat Inspection have been fully embraced ; and, veterinary science, *inter se*, has now come to the stage of being considered a part and parcel of a bigger science of " Animal Husbandry ", or better, " Animal Industry ", the main planks of which are breeding, feeding, care and management of all domestic animals including poultry and fish, along with the exploitation of all animal products. In short, the science of Animal Husbandry now is supposed to include all that appertains to domestic animals and their products. This change in the outlook on " Veterinary Science " is a striking indication of the ability of the veterinary profession to march with the times and blaze new trails, as well as of its vitality, awareness and progressiveness. Today, in all civilised countries opinion is almost unanimous that a veterinarian should not restrict himself to the treatment and prevention of animal diseases only, but should also act as an adviser on matters relating to the choice of animals and breeds, animal management, animal nutrition, utilization of animal products, stock-raising, dairying, poultry husbandry, public health, etc.

* This is the twelfth of a series of popular articles for practical farmers on various animal husbandry subjects of general interest.

ANIMAL HUSBANDRY

It is difficult to state exactly what is implied by the term "Animal Husbandry". The danger of definitions is that the very act of defining creates limitations of thought, but it is probably sufficiently inclusive to say that 'Good animal husbandry is the art of keeping domesticated animals remuneratively healthy". A more comprehensive definition of animal husbandry has recently been given by Mr. F. Ware*, C.I.E., F.R.C.V.S., I.V.S., Director of the Imperial Veterinary Research Institute, Mukteswar as: "Animal husbandry may be defined as the art of producing, maintaining and disposing of the different species of domestic animals and poultry in the best possible manner for those uses which man requires of them, and, in the same way as the scientific method is considered essential for progress in most other walks of life, so in this subject it is necessary to remember that any contemplated development should be based on the three sciences of veterinary medicine, animal nutrition and animal genetics. The analogy of animal husbandry amongst the live-stock population to public health amongst the human population will thus be seen." In other words, animal husbandry consists of those aspects of breeding, rearing, feeding and managing healthy animals, which result in the production of the best of which an animal is capable.

Speaking generally, animal husbandry is one of the key industries of the British Empire, and the statistics† given for the United Kingdom and the Dominions show that out of a total farming output valued at about £1,000 million (1928), approximately two-thirds is derived from domestic animals and animal products. This is particularly so in India where the main occupation of the people is agriculture of which the keystone is live-stock and safeguard the veterinary profession. For obvious reasons, therefore, in practical animal husbandry operations too much stress cannot be laid on the maintenance of animals' health and efficiency, including protection from the ravages of disease. It would be no exaggeration to say that the maintenance of animal health is an all-important factor in the success of agricultural life and procedure in India, more particularly when it is remembered that healthy animals and sound animal products, in a great measure, reflect the health of the human community.

FOUNDATIONS OF ANIMAL HUSBANDRY

The foundations of animal husbandry are laid, like that of medical science, in the basal sciences of Physics, Chemistry, Botany and Zoology. To qualify as a veterinary surgeon a working knowledge of these subjects is considered absolutely essential, and to be a good animal husbandman one must be well up in biology. In all curricula of veterinary studies at the different veterinary schools and colleges of the world, a major portion of the first year's studies consists of instruction in these basal sciences. It would, however, be seen that physics and chemistry are really

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†*Agric. & Live-stock in Ind.* **4**, 98.

complemental to the study of biology, for to become a competent biologist and to know what an animal does, how it does it and why it does it, the candidate must have at least a grounding of physics and a sound knowledge of chemistry.

Zoology

Considered roughly, zoology may be held to mean as the general science of animals. All considerations regarding animals come in its domain: animal morphology (including embryology, histology, descriptive, comparative and topographical anatomy); animal physiology embracing considerations regarding the application of the known laws of physics and chemistry to explain the normal and pathological functions of living animals; animal classification; their present distribution and past development; their breeding, individual development and natural history in the field; their sexuality and their heredity, as well as their diseases are all parts of one and the same discipline, *viz.*, Zoology. Strictly speaking, animal husbandry as dealing with domesticated animals only, is a child of the parent subject of zoology which deals with the entire animal life from the lowest protozoan organisms to the highest mammals.

Research in zoology

The advance in investigation and knowledge of zoology has naturally led, as in other sciences, to specialisation, and its sub-divisions, *i.e.*, Protozoology, Helminthology, Entomology, Cytology, etc., are now fully recognised as almost separate entities. So far as applied zoology is concerned, its main divisions are referable to human and veterinary medicine, some aspects of forestry, agriculture, the storage of foods, fishery research, silkworm culture, economic entomology, general parasitology and genetics. Systematic zoologists and specialists in the various divisions of zoology, like the physicists and chemists, have been continually adding during all this period to the store of linked ascertained facts about almost every aspect of animal life, little thinking of what great use and practical application their discoveries would ultimately be. The practitioners of human and veterinary medicine and surgery have liberally drawn upon their investigation and research and have sifted out material that they needed in the exercise of their occupations for the relief of suffering and prevention of disease. All the same, a pure zoologist is generally supposed to be a narrow specialist concerned mainly with the trivial details of and superficial distinctions between the members of the same narrow group of organisms which he studies in the spirit of a stamp collector. He is a scientist, pure and simple, and is not seeking something necessarily useful. He is, however, seeking knowledge, and all knowledge is powerful and potentially useful. Again, there is a certain amount of aesthetic satisfaction to be derived from the study of minute morphology and orderly arrangement of the numerous and varied forms found in any natural group of organisms, but there is also a tendency to be

discerned amongst certain workers for this very useful foundation work to outlive its usefulness. They cover it under the cloak of their ultra-academic sentiment that ' polite learning and true culture admit no contact with utility.'

If one considers for a moment what the zoologists have already achieved in their attempts to understand animals, to investigate their life-histories and to gain an insight into man's surroundings with a view to shape them to suit his ends, one must admit that they have, indeed, made remarkable progress. Yet, if on the other hand, one considers what the zoologists do not know about animals, one cannot avoid the conclusion that they have so far merely scratched the surface of the subject, and that a wealth of knowledge still remains to be discovered. For instance, if all that has been written about domesticated and wild animals and their parasitic forms were collected, it would fill a huge library and it would contain such a large amount of information that one person could not possibly make it all his own during a lifetime. And, still we find that as soon as we come to the details of some practical problem --say, the life-histories of the different parasitic worms which are responsible for heavy losses, our knowledge is quite inadequate for the control of pests caused by them, and we realise that man's complete mastery over the living creatures of the world is yet a long way off.

Veterinary problems from a zoological point of view

As has been observed before, the chief problems confronting a verterinary surgeon in his practical animal husbandry operations are : prevention of disease ; feeding and care of animals under varying conditions, and live-stock breeding.

Preventive medicine in veterinary science is largely a matter of biology, of which zoology is an important part. Besides bacterial and nutritional diseases of live-stock, diseases caused by the protozoan parasites, helminths, insects and arachnids are numerous. It has been estimated that the annual loss of national wealth in India due only to the attacks of insects and arachnids on domesticated animals is approximately four crores of rupees.* Insects and arachnids worry and annoy animals leading to a considerable loss of energy and health which is directly reflected in reduced efficiency of animals ; cause direct injury by biting, poisoning and blood sucking ; set up dermatosis, myiasis and setiasis ; help greatly in the dissemination of pathogenic organisms, and in certain cases they act as intermediary hosts of the causal agents of important diseases. Helminths generally set up a prolonged and progressive afebrile unthriftiness in infested animals, which become reduced in vitality and resistance to diseases. Apart from this, they cause damage to live-stock by depriving them of their food ; feeding actually on their tissues ; mechanically causing obstruction, pressure or irritation ; causing abrasions through which infection may find its way and forming nodules and tumours. Some of these

*_Journ. of the Cent. Bur. of Anim. Husb. & Dairying in Ind._ Vol. I, Pt. I, April 1927. Pp. 9 and 10. (T. Bainbrigge Fletcher and S. K. Sen.)

parasites produce powerful poisons and bring about toxaemic conditions, *e.g.*, tick-toxaemia and toxaemia in hook-worm disease. It is difficult to estimate the extent of the annual loss accruing to the country on account of helminthic infestation of domestic animals, since the effects produced are indirect and are seldom pronounced or spectacular enough to attract immediate attention, but the figure, in all probability, far exceeds that for the losses due to insects and arachnids. Reduced productivity, *e.g.*, in milk yield, and inefficiency, *e.g.*, in working capacity of Indian live-stock is, in no small measure, due to this cause. It goes without saying that a working animal cannot support a large number of parasites some of which are blood-sucking, and at the same time render full service. Diseases of animals caused by protozoan parasites are also numerous, the important ones being Coccidiosis, Piroplasmosis, Trypanosomiasis, etc. The transmission of some of these diseases is by the agency of intermediary hosts, the so-called 'vectors' which may be insects or arachnids. Serious diseases like Surra, Redwater, East Coast Fever, Malaria, etc., come under this category.

A large proportion of our Indian live-stock population suffers from one or more of the aforesaid parasitic infections. If we could clear them away, we would have an entirely new India with a new outlook on the exploitation of our animal wealth and new possibilities of prosperity.

Proficiency in the eradication, control and prevention of disease implies a profound knowledge of the cause, for without this our labours go awaste and our efforts are discredited. Here the zoologists come to the rescue of the veterinarians. They help in defining the cause with scientific exactitude and make it possible for the veterinarians to determine accurately the preventive and remedial measures with a view to apply the same appropriately to obliterate disease or minimise its effects. Indeed, the first plank of disease is its cause ; remove the cause and the disease ceases. It is like crime in this respect. It must, however, be remembered that the elucidation of cause and effect is not altogether a one-man or two-men issue. There are so many sides of disease that the definition of causation alone requires the collective effort and opinion of experts in special sciences before any tangible summing up can be arrived at. A suitable team of research workers, including physicists, chemists, botanists, biochemists, zoologists, veterinary surgeons, etc., must all collaborate and render necessary aid in the survey of circumstances which point to the different aspects of disease. As has been mentioned before the services of a zoologist are particularly indispensable in the field of veterinary parasitology including Protozoology, Helminthology and Entomology, for even till today the life-histories of a number of parasites which set up a variety of diseased conditions in domestic animals and are responsible for heavy losses to the country, remain to be worked out. Again a veterinary surgeon need not necessarily follow blindly the outlook of a pure zoologist in preventive medicine for the solution of disease problems in animals. He may not carry out an intensive study of the parasites for their own sake as a zoologist would do. He should focus his

attention more on the disease, its aetiology, intermediary hosts and their eradication, pathology, treatment and prevention, rather than on the biology of the parasite, which forms only a part of his legitimate duties. To put it rather tacitly, from a practical stand point a veterinary field worker should correct his proportions and should not become so much engrossed with the parasite as to forget the disease.

Stock-raising, rectification of the effects of malnutrition and underfeeding, proper care and management of domesticated animals and their scientific breeding are other problems of animal husbandry in which a knowledge of biological principles, physiology and biochemistry come in handy for veterinarians. These are factors which are mainly concerned in maintaining an individual's power of resistance at an optimum and without these even success in prevention of disease can neither be complete nor satisfactory. Animal breeding has been very aptly defined by Dr. Crew* as "an adventurous experimental study in applied biology". It is an art which is based upon the accumulated experience of countless generations of animal husbandmen, and it has been brought to its present level of excellence mainly by methods of trial and error. Still it must be admitted that for the elucidation of the breeders' problems which are varied and continuously arising in their breeding practices, the help of scientifically trained men in the science of genetics must be enlisted. The science of genetics deals mainly with the principles of evolutionary biology; the physiology of heredity—the mechanism by which resemblance between parent and offspring is conserved and transmitted; and the origin and significance of variation—the mechanism by which such resemblance is modified and transformed. A breeder who carries on his work without a sufficient working knowledge of genetics cannot achieve the highest success in the minimum of time.

*F. A. E. Crew. "Animal Genetics". 1925. Olver and Boyd, London.

GENETIC IMPROVEMENT OF WHEAT IN BOMBAY

2. BANSI-168 AND BANSI-224

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Introduction

In a previous paper [Kadam & Kulkarni, 1938] the authors have described an improved strain, Bansipalli-808, which is spreading in the Nasik and Ahmednagar districts of the Deccan and in the wheat tract of Karnatak. These areas constitute nearly 60 per cent of the acreage under wheat in the province. Most of the remaining area is divided between the Bhal tract of the Ahmedabad district of Gujarat and the West and East-Khandesh districts. In these two zones the two improved strains, Bansi-168 in West-Khandesh and Bansi-224 in East-Khandesh and in the Bhal tract, are now replacing local wheats. In this paper botanical descriptions of these strains and their behaviour in the districts are briefly given.

History of the strains

From the original selections made in 1918-19 from the local Bansi wheat by Chibber, the first Plant Breeding Expert, four selections, Bansi-162, Bansi-103, Bansi-224 and Bansi-168, were finally obtained in the year 1922-23. After four to five years' trials with these strains it was concluded that Bansi-162 and Bansi-103 were appreciated in Trans-Tapti valley and Nasik tract and Bansi-224 in the East-Khandesh and in the Bhal tract of Gujarat. Bansi-168 was considered inferior to local wheat [Nazareth, 1931]. But further experience with Bansi-162 and Bansi-103 showed that they were unsuitable and had to be eventually withdrawn. Bansi-224, however, managed to maintain its popularity. The strain Bansi-168 was introduced as an alternative to Bansi-162 and has proved a great success. In place of Bansi-103, the synthetic strain, Bansipalli-808 is now spreading in the Nasik district.

* Deceased.

Botanical description

Before describing the improved strains, it may be useful to give a brief description of the local Bansi wheat from which these strains are derived. Throughout the Deccan the dry wheats, as grown by the cultivator, are a mixture of many agronomic forms. The crops consist of brown-glumed and brown-awned and white-glumed and white-awned plants in various proportions; the proportion of white-glumed plants increasing as one travels towards East-Khandesh. In the Deccan, yellow grained Bansi wheat is grown, but it contains mixture of red grains, which varies from place to place. The appearance of local Bansi grain is usually dull, as it consists of many types with varying gradations of colour and lustre. The crop consists of early and late plants, mostly the latter. In the market, the produce from local varieties is generally priced lower than that of any one of the improved strains.

The two improved strains differ but little from the local Bansi morphologically, but agronomically they are a definite advancement over the cultivators' varieties. Both the strains have smooth brown glumes and awns. The grain colour of Bansi-168 is lighter and is more attractive than that of Bansi-224 which possesses a grain with a distinct reddish tinge and an oily appearance. The botanical and agronomical features of both these strains and the local variety are summarized in Table I.

Table I

Intensive study of characters of local Bansi strain No. 168 and 224 during the years 1933-34 to 1936-37

Character	Year	Local Bansi	Bansi-168	Bansi-224
(1) No. of days from sowing to flowering	1933-34	72·6±0·41	63·9±0·36	72·2±0·41
	1934-35	70·7±0·22	67·2 ±0·33	70·9±0·22
	1935-36	76·0±0·41	66·8 ±0·33	75·1±0·55
	1936-37	75·0±0·59	62·3±0·44	71·8±0·52
	Average .	74·6	65·05	72·5
(2) No. of tillers per plant .	1933-34	3·2±0·15	2·8±0·13	4·1±0·25
	1934-35	6·0±0·24	5·1±0·26	6·1±0·20
	1935-36	8·4±0·77	5·9±0·29	6·9±0·66
	1936-37	7·6±0·20	5·9±0·30	8·0±0·53
	Average .	6·3	4·9	6·3

TABLE I—*contd.*

Character	Year	Local Bansi	Bansi-168	Bansi-224
(3) Length of main spike in cms.	1933-34 1934-35 1935-36 1936-37	7·38±0·11 8·63±0·08 8·60±0·17 8·71±0·69	7·52±0·08 8·82±0·09 9·10±0·10 8·65±0·10	8·36±0·13 8·73±0·08 8·38±0·14 8·85±0·12
	Average .	8·33	8 52	8·58
(4) No. of spikelets on the main spike	1933-34 1934-35 1935-36 1936-37	13·9±0·18 17·6±0·17 14·7±0·40 15·8±0·68	13·8±0·11 16·7±0·14 15·5±0·17 15·9±0·54	14·5±0·18 17·9±0·14 14·5±0·24 16·0±0·53
	Average .	15·5	15·5	15·7
(5) Density of spikelets on the main spike	1933-34 1934-35 1935-36 1936-37	0·53±0·003 0·49±0·003 0·56±0·007 0·54±0·005	0·54±0·004 0·53±0·005 0·57±0·004 0·53±0·005	0·58±0·005 0·49±0·009 0·56±0·005 0·53±0·004
	Average .	0·53	0·54	0·54
(6) No. of grains per grm. .	1933-34 1934-35 1935-36 1936-37	23·4±0·28 22·5±0·17 22·7±0·41 22·4±0·34	22·8±0·26 24·1±0·11 20·2±0·50 21·6±0·33	22·8±0·41 21·9±0·14 21·4±0·96 20·5±0·82
	Average .	22·7	22·2	21·7
(7) Length of grain in m. m. .	1933-34 1934-35 1935-36 1936-37	7·68±0·03 7·90±0·03 8·00±0·71 7·87±0·10	7·60±0·03 7·70±0·02 8·15±0·37 8·00±0·44	7·76±0·04 8·10±0·03 8·29±0·67 8·13±0·17
	Average .	7·86	7·86	8·07
(8) Breadth of grain in m. m. .	1933-34 1934-35 1935-36 1936-37	3·02±0·03 3·20±0·02 3·20±0·41 3·06±0·50	3·03±0·02 2 90±0·03 3·40±0·46 3·06±0·14	2·87±0·04 3·10±0·02 3·20±0·41 3·00±0·10
	Average .	3·12	3·09	3·04
(9) Yield of grain per plant in grms.	1933-34 1934-35 1935-36 1936-37	4·2±0·61 9·7±0·37 12·0±1·10 10·9±0·95	5·3±0·99 10·7±0·68 10·8±1·49 8·1±0·54	5·9±0·44 10·5±0·43 10·3±1·09 11·5±0·85
	Average .	9·2	8·7	9·5
(10) Bushel weight in lbs. .	1935-36 1936-37	67·17 57·91	67·87 58·65	68·00 64·71
	Average .	62·54	63·26	66·355

TABLE I—*concld.*

Character	Year	Local Bansi	Bansi-168	Bansi-224
(11) Weight of 1,000 grains in grms.	1935-36 1936-37	39·2 22·8	45·1 24·6	44·20 31·22
	Average .	31·0	34·85	37·71

During the season of 1934-35 the strain Bansi-168, being early, suffered from frost in mid-January 1935. This is reflected in the development of grain. There was a very heavy epidemic of stem rust during 1936-37, which very badly affected all the varieties.

Table I shows that Bansi-168 is earlier by ten to twelve days to the local and Bansi-224. The grains of Bansi-224 are slightly longer. Although the bushel weight is about the same, the 1,000 grain weights show that the selections are decidedly heavier than local Bansi.

BEHAVIOUR ON THE FARM

Bansi-168 and Bansi-224 and local Bansi were compared with other wheats from 1932-33 to 1936-37 at the Cereal Breeding Station, Niphad. During the first three seasons all the three varieties were compared in Latin Square replications. In the next two seasons only Bansi-168 and local Bansi were compared with other strains in randomized blocks. Bansi-168 gave slightly more yields than local Bansi in all the years except in 1936-37, in which year both suffered heavily from stem rust. Bansi-224 is equal to local Bansi. The average yields, slightly over 700 lbs. per acre, of all the three varieties, show that under farm conditions all of them are equally good yielding.

DISTRICT TRIALS

West-Khandesh.—The area under wheat in this district is about 150,000 acres and is concentrated almost entirely in the talukas of Taloda Shahabad, Nandurbar and Sindkhed. Those are situated along the banks of Tapti and represent one of the best soil tracts for wheat. As stated above, Bansi-162 was found to be more suitable for this tract than the other strains. However, after a year or two, complaints began to come that Bansi-162 is somewhat late and that its grain is not so attractive as desired. Moreover, the yield of the improved strain was not much larger than that of the local variety, although it ripened a week later. It was, therefore, decided to compare Bansi-168 with Bansi-162 and with the local variety in West-Khandesh as the new wheat had the advantage of a more attractive grain and earlier maturity. The results [Kadam, 1929-30; 1930-31; 1931-32; 1932-33; 1933-34 and 1934-35] of district trials are recorded in Table II.

TABLE II

District trials of Bansi-162, Bansi-168 and local Bansi wheats in West-Khandesh during the years 1930-31 to 1934-35

Name of village	Taluka	Year	Local	Bansi-162	Percentage increase over local	Bansi-168	Percentage increase over local
Shahada .	Shahada .	1930-31	497	577	16·1	622	25·1
Nizar . .	Nandurbar	1932-33	392	476	21·4	490	25·0
Shahada .	Shahada .	..	1,300	1,380	6·1	1,640	26·1
Shinde . .	Ditto .	1933-34	450	540	20·0	564	25·3
Shahada .	Ditto .	.	872	834	—4·3	912	4·6
Marrad . .	Ditto .	..	546	562	2·9	492	—9·9
Pimprad .	Ditto .	..	344	412	19·8	414	20·3
Shindkhed .	Shindkhed	1934-35	762	.	..	854	12·1
Nandurbar .	Nandurbar	..	400	..	..	550	37·5
Average .	..	..	618	683	10·5	726	17·5

It will be seen that both the strains are better than the local variety. Bansi-168 exceeds the local in yield at all the places except one, showing increased yields from 4·6 per cent to 37·5 per cent. Bansi-162 also gives higher yields than the local, but is not so prolific as Bansi-168.

East-Khandesh.—This district grows over 45,000 acres of wheat annually. Most of the area is located in the talukas of Amalner, Erandol and Jalgaon. These talukas are along the coast of the Tapti river and form a continuation of the wheat-tract of West-Khandesh. Of the four Bansi strains, Bansi-103,-162,-168 and 224, tried in East-Khandesh, Bansi-224 has proved popular from the beginning. The results of trials obtained during the seasons of 1923-24 to 1927-28 are given in Bulletin No. 166 of the Department [Nazareth, 1931].

During the three years, 1932-33 to 1934-35, trials were again made using only Bansi-224 against the local variety in various talukas of East-Khandesh. These results [Kadam, 1932-33; 1933-34 and 1934-35] are given in Table III.

TABLE III

District trials of Bansi-224 in East-Khandesh district during the years 1932-33 to 1934-35

Name of village	Taluka	Year	Local	Bansi-224	Percentage increase over local
Rotwad . . .	Erandol .	1932-33	310	352	13·5
Mumurabad . .	Jalgaon . .	1933-34	500	797	59·4
Jalgaon . . .	Ditto .	1934-35	1,071	1,188	10·9
Erandol . . .	Erandol . .	1934-35	480	540	12·5
Chalisgaon . .	Chalisgaon .	1934-35	758	920	21·4
Average . . .	..	.	624	759	21·6

It will be seen that the improved strain has given considerably higher yields over the local wheat, the average increase being over 21 per cent. Taking the yields of all the years since 1923-24, Bansi-224 gives 829 lbs. average yield per acre as compared to 707 lbs. of the local, or an increase of 17 per cent.

Bansi-224 has also proved suitable to the Bhal tract of Gujarat. Out of nearly two lacs of acres of dry wheat in Gujarat, about 145,000 acres are concentrated in Dholka and Dhanduka talukas, forming the Bhal tract of the Ahmedabad district. Trials from the very beginning have shown that Bansi-224 is superior in yield to local wheats, Dhola-katha (yellow-grained) and Rata-katha (red-grained). These results are reported by Patel [1935]. The improved strain showed increases in yield over the local wheat from about 6 to 20 per cent, the average being 10 per cent.

DEFECTS OF THE IMPROVED STRAINS

The greatest drawback of Bansi-168 and Bansi-224 is that they are susceptible to stem rust. Although the appearance of rust is not an annual feature in Khandesh, nevertheless the farmers desire that the improved strains should possess the rust-resisting property.

Bansi-224 ripens a week later than the local wheat in East-Khandesh. An earlier wheat, with the same, if not more, capacity for yield will be more welcome. Another chief complaint is that the straw of Bansi-224 is coarser and hence cattle do not relish it so much as the straw of the local wheat, the opinions, however, differ on this point.

In Gujarat the reddish tinge of the grain of Bansi-224 is not liked, although the uniform size and even appearance of the grain fetches a premium of at least 10 per cent over the local Dhola-katha wheat. A higher yielding wheat with an attractive lighter grain-colour than that of Bansi-224 will be more appreciated.

Possibility of replacing Bansi-224 by Bansi-168 in East-Khandesh

It has been stated above that an earlier wheat would be more welcome in the East-Khandesh, as Bansi-224 is about a week later in ripening than the local wheat. Instead of introducing an altogether new wheat it will be more advisable first to undertake trials with Bansi-168 in this district to see if it can replace Bansi-224. If Bansi-168 proves equally suitable as the other wheat, we will have one variety for the whole of the Khandesh tract, which comprises nearly two lac acres of wheat area. It will also greatly simplify the propaganda work which is being done at present , in the Khandesh districts in favour of these two wheats. The possibility of replacing Bansi-224 by Bansi-168 is evident from the yield records of the two strains grown on large scale since 1932-33 on the Government Farm at Jalgaon (East-Khandesh). As accurate large scale yield data of improved strains are seldom available it is considered worth-while to reproduce the information in Table IV.

Table IV

Average yields of Bansi-224 and Bansi-168 grown on Jalgaon Farm from 1932-33 to 1936-37†

Year	Bansi-224			Bansi-168		
	Actual area sown		Yield per acre in lbs.	Actual area sown		Yield per acre in lbs.
	Acres	*Gunthas*		Acres	*Gunthas*	
1932-33 . . .	26	16	932	8	34	784
1933 34 . . .	20	14	999	22	7	1,200
1934-35 . . .	13	13¾	1,045	17	33½	980
1935-36 . . .	10	1½	896	15	3	876
1936-37 . . .	8	4¾	1,011	20	20	1,181
Average* . . .	..	..	972	..	..	1,044

† Data kindly supplied by Mr. B. V. Waishampayan, B.Ag., Superintendent, Jalgaon Farm.

* On the basis of total production from the whole area.

From Table IV it will be seen that both the strains are more or less equal in yield throughout the five-year period. In average yields, however, Bansi-168 gives seventy-two lbs. more yield than Bansi-224.

SUMMARY

1. Two improved strains of wheat Bansi-168 and Bansi-224 derived by selection from the local Bansi wheat (*T. durum*, Desf.) of Bombay are described.

2. Bansi-168 is now a standard strain in the West-Khandesh district and Bansi-224 has proved suitable to the Bhal tract of Gujarat and to the East-Khandesh district.

3. Possibility of replacing Bansi-224 by Bansi-168 in East-Khandesh is pointed out.

4 Both the wheats are susceptible to black stem rust.

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A PRELIMINARY NOTE ON THE STUDY OF OESTRUS IN SHEEP

DIOESTROUS CYCLE IN BIKANER EWES

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THE factors influencing profitable sheep farming are manifold and to aim at a high degree of fertility in the ewes is one of them. Considering ewes as productive units in this financial concern, the object of an enterprising breeder should be to get the highest percentage of lambs out of his flock at the lambing season. The varying degree of fertility noticed in flocks is either due to the infertility of the rams or defective management of the ewes which do not enable them to carry out their normal functions during the mating period. In order to make the best use of the sexual behaviour of individual ewes at different times of the year the knowledge of all the phenomenon connected with reproduction is most essential. In this respect, a full study of oestrus in its various aspects seems important.

Oestrus or heat may be described as the signal of sexual activity and marks the time during which the ewe shows a desire to be served by a ram. The mutual behaviour of the male and the female is a reliable indication of oestrus. The duration of heat has been observed to last on an average of twenty-four hours although it varies considerably in individual animals. Cases have been noticed by Roux [1936] in South Africa where it has extended over a period of ninety-six hours in Merino ewes.

Ovulation or setting free of the egg cell from the ovary occurs during a certain stage of the oestrus and it is only when the ova has been set free previous to or immediately after mating that conception is possible with certainty. Each of these two phenomenon sometimes occur independently and in such cases either mating does not take place or fertilization fails.

If the mating has proved fruitless the ewe will again come into heat after a certain definite period (the dioestrous cycle) the cycle completing on the onset of the next oestrus. During this period sexual desire is latent and there is no indication of heat or setting free of ova. A continuous series of dioestrous cycles by the

majority of the ewes constitutes a sexual season. According to W. Heape [1901] sheep has been described as a polyoestrous mammal showing a series of oestrus cycles during the oestrus season. In order to give a fair chance to the ewes to prove their fertility it seems most necessary that the mating period should be so fixed as to coincide with the sexual season.

Although sheep are bred all the year round in the Punjab and the lambs are dropped throughout the whole year a closer scrutiny reveals that under ordinary pastoral conditions in the villages, the maximum number of lambs are dropped during spring and autumn. This indicates that there exist two sexual seasons. These would approximately be during October, November, December and April, May and June just after the harvest of *kharif* and *rabi* crops, when the grazing available is in abundance. The number of spring lambs is more marked especially in the *barani* tracts probably due to the fact that the area under *kharif* crops being always larger provides extensive feeding of stubbles. Also, the stubbles having already been enhanced with grasses by the rains during July, August and September, the ewes are thoroughly flushed by prolonged luxurient grazing. This also throws some light on the fact that flushing of the ewes before and during the tupping season plays an important role in effecting the maximum number of conceptions. While getting one crop of lambs a year it has already been suggested on experimental basis [Smith and Mumtaz, 1935] that the best suited mating period is from the 15th of March to the 15th of June. In the irrigated tracts, no doubt, the flushing of the ewes is carried satisfactorily during this period on the stubbles and fallen grains of the *rabi* crops but in order to further advocate the advisibility of this period it would be worthwhile to study the sexual behaviour of the ewes during this interval.

During the course of recent experimental work (Cross breeding Corriedale and Bikaner sheep) certain observations have provided some information on the subject which may be of interest and value to the sheep breeders.

On the 15th of March 1937 two Corriedale rams were given eight Bikaner ewes each and placed in two separate *baras*. As a general practice the rams were put with the ewes only during the night time and were taken off in the day. To ensure that a particular ewe has been served a simple device was used. It consisted of making a thick coloured solution which was placed on the breasts of the rams, just before putting them in their respective *baras*. Concurrently the hind quarters and backs of all the ewes were saturated with water so that the colour might be easily transferred to them. Any ewe tupped during the night showed a distinct mark on the quarters the next morning. To avoid the occurrence of any mistake the colour was changed after every week. The observations recorded are given in Tables A and B.

It is noted that a number of ewes exhibited successive oestrus at definite intervals and were served up to five times during the whole of the mating period. It is further noticed that the duration of dioestrous cycle varies from fifteen to nineteen days. Cycles twice or thrice the normal length are seen in ewes Nos. 603, 387, 578 and 421, these are cases in which the intermediate oestrus was not observed, perhaps owing to an abnormally short oestrus or an oestrus at which ovulation occurred without showing any heat or it be possible that the ewes aborted but no blood or after birth was observed in any case. In the case of ewe No. 421 (Table A) the mating occurred on the succeeding nights also at two occasions (26th April 1937, 27th April 1937 and 16th May 1937, 17th May 1937) suggesting that heat in this case prolonged to more than twenty-four hours. Only one ewe did not show any heat and was not served at all. The tables also show that some of the ewes were served many times and the services proved futile. As it is not yet fully understood why this irregularity was exhibited, further work is required to investigate the cause.

In view of the fact that the ewes failing conception have been continuously coming into heat up to the 15th of June 1937 we can safely fix this as the breeding season. Moreover a study of the breeding records of the Hissar dale and Bikaner flocks at the Government Cattle Farm, Hissar, show a fairly high lambing percentage of nearly 82 per cent average of the last three years. This is a further proof of having rightly adjusted the breeding season more especially when it is known that the loss in percentage is mainly due to the non-production of the maiden ewes or old ewes.

A number of experiments conducted by Dr. Roux [1936] in South Africa reveal that there exist considerable individual differences in the sexual activity of the ewes. These differences were noticed even in ewes in the best condition and kept on well balanced ration. He noticed that some ewes experienced fifteen or more dioestrous cycles during a sexual season while others under similar conditions showed one, two and three cycles. Since ovarian activity is closely related to fertility which is probably a hereditary character, one is justified to believe that such animals which show such limited sexual behaviour transmit this character to the progeny. This limited activity is not shown frequently during the tupping season therefore such individuals will not mate and should be considered infertile.

Although further work is in progress we are able to draw the following conclusions :—

1. The dioestrous cycle in Bikaner ewes varies from fifteen to nineteen days.
2. The varied period is not only marked in different individuals but in the same individual also.
3. The duration of heat may extend from a short period to more than twenty-four hours. (The study of definite limits of the period is in progress.)

4. That the period from the 15th of March to the 15th of June can safely be fixed as the mating season.
5. Flushing ewes prior to the breeding season plays an important role in bringing a fairly high degree of fertility. (To prove this further experiments are in progress.)
6. According to Dr. Roux those cases which have a limited sexual behaviour and do not show it frequently during the tupping season should be considered infertile.

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TABLE A

Bara *with ram No. J. R. G. C. L. 3 T. T. 218*:

Age about $4\frac{1}{2}$ years

Serial No.	Ewe No.	Dates of services with the intermediate intervals									The intervals or the dioestrous cycle	Remarks
		Served on	Interval	Served on	Interval	Served on	Interval	Served on	Interval	Served on		
1	592	23rd March 1937	17 days	9th April 1937	19 days	28th April 1937	16 days	14th May 1937	17 days	31st May 1937	16, 17 and 19 days	Empty
2	533	27th March 1937	...	...	..	...	...	...	...	...	...	Lambed on 26th August 1937
3	348	24th March 1937	...	...	. .	...	...	...	...	...	...	Lambed on 20th August 1937
4	603	26th March 1937	48 days	13th May 1937	18 days	31st May 1937	...	...	...	...	18 and 48 days	Empty
5	381	29th March 1937	18 days	16th April 1937	17 days	3rd May 1937	34 days	...	...	...	18, 17 and 34 days	,,
6	392	23rd March 1937	...	...	...	...	...	...	...	...	...	Lambed on 29th August 1937
7	441	15th May 1937	17 days	1st June 1937	...	..	...	...	...	...	17 days	Empty
8	553	...	...	...	. .	...	...	...	...	...	...	,,

The intervals of 48 days and 34 days show three times and dou'le the normal period.

TABLE B

Bara *with ram No. J. R. G. C. L. 3 1706* :*

Age about 5 years

Serial No.	Ewe No.	Dates of services with the intermediate intervals										Remarks
		Served on	Interval	Served on	Interval	Served on	Interval	Served on	Interval	Served on	The intervals or the dioestrous cycle	
1	453	3rd April 1937	17 days	20th April 1937	17 days	7th May 1937	19 days	26th May 1937	17 days	12th June 1937	17 and 19 days	Empty
2	387	24th March 1937	36 days	29th April 1937	17 days	16th May 1937	19 days	4th June 1937	...	...	17, 19 and 36 days	,,
3	608	29th March 1937	18 days	16th April 1937	18 days	4th May 1937	...	...	...	...	18 days	,,
4	512	31st March 1937	19 days	19th April 1937	18 days	7th May 1937	19 days	26th May 1937	16 days	11th June 1937	16, 18 and 19 days	,,
5	578	29th March 1937	32 days	30th April 1937	...	...	..	...	...	...	32 days	,,
6	479	25th March 1937	19 days	13th April 1937	19 days	2nd May 1937	19 days	21st May 1937	...	...	19 days	,,
7	288	3rd April 1937	18 days	21st April 1937	18 days	9th May 1937	16 days	27th May 1937	18 days	14th June 1937	16 and 18 days	,,
8	421	8th April 1937	18 days	26th April 1937 and 27th April 1937	19 days	16th May 1937 and 17th May 1937	15 days	1st June 1937	...	...	15, 18 and 19 days	,,

The intervals of 36 and 32 days show double the normal period.

*The ram was later found to be infertile.

ROLE OF MOSQUITOES IN THE TRANSMISSION OF ANIMAL DISEASES

BY

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Introduction

Veterinary Entomology as a vital necessity in the progress of this country has been recognised only comparatively recently in India. Incidentally the importance of mosquitoes in the dissemination of animal diseases, has remained obscure so far in the annals of Indian Entomology. Periodic attempts have, however, been made in this institute (Mukteswar) to gauge the economic implications of mosquitoes in relation to Indian live-stock, but these studies have been largely inconclusive, the main difficulty contended with being the fact that the work had to be concentrated at an altitude unfavourable for mosquito life. It is not surprising, therefore, that most of our knowledge on this group of insects as far as the veterinary side is concerned, has remained imperfect, and is primarily based on foreign publications.

The association of mosquitoes with the medical and public health problems on the other hand has received adequate attention from workers in India, and new light is being constantly thrown on the existing knowledge of mosquitoes involved in the causation of various disease entities of human beings, and the recognition of this association has been such an age-long one that any realisation of their importance to other spheres of the organic world is bound to be slow to an average mind. To make this statement more clear, it will perhaps be not out of place here to mention briefly a few outstanding researches relating to the importance of mosquitoes in human pathology.

In discussing the human diseases borne by mosquitoes the one that comes foremost in our minds is the epoch-making discovery of Ross and Grassi who conclusively established that the human malaria is transmitted through the agency of mosquitoes belonging to the genus Anopheles. The stepping stone of tropical medicine was laid so to say, by the discovery by Manson of the mechanism of human filarial transmission through the agency of Culex mosquitoes. Yellow fever in Africa has also since been found to be disseminated by a species of Aedes (Stegomiya) mosquitoes. The same species *Aedes aegypti*, characterised by white bands in the legs and thorax, and which is a virulent day-biter, is also recently

proved to be a vector of the agonising disease known as dengue, the causative agent concerned being a filterable virus.

As science has progressed and more knowledge on the behaviour of this highly interesting group of insects has accumulated, several more of these creatures have been found to have assumed vectorial character. For instance, while *Culex fatigans*, the common brown mosquitoes of Indian homes, is the principal intermediate host of the nematode worm *Wuchereria (Filaria) bancrofti*, the producer of elephantiasis and other lymphoid diseases of human beings, Mansonia, another culicine genus, has also recently been incriminated as a carrier of related worms ; and the author has on his observation an instance where a species of Anopheles, *viz.*, *A. hyrcanus* was found to be carrying the worm in its proboscis. It is probable that the latter group of mosquitoes are also capable of transmitting the disease and are of much more importance than hitherto believed. *Aedes aegypti* again has often been incriminated as a carrier of human filariasis by different workers. In the same way, the transmission of human malaria by Culex mosquitoes has been effected experimentally though evidence is yet lacking as to their capability of acting as a natural carrier.

From what has been said above it is clear that mosquitoes play a vital part in the transmission of several diseases of human beings. Nevertheless, in recent years mosquitoes have assumed a position of considerable interest in veterinary science also, and in no less unmistakable a way they are incriminated in the transmission of some animal and poultry diseases. Both malaria and microfilariasis are common among certain animals as well, but these diseases of the lower animals have not attracted sufficient attention of the investigators.

Apart from the diseases that might be spread among animals and poultry by mosquitoes, their noxious bites cause a considerable inconvenience to the dumb creatures and adversely affect their productivity. The intensity of mosquito infestation of animal sheds may be somewhat realised from the fact that in a recent investigation in Bengal the author could detect the presence of eleven species of anopheline mosquitoes alone in addition to the other culicine species [Sen, 1937].

The diseases coming under the scope of veterinarians that are known or suspected to be propagated by the different mosquitoes are enumerated in the following pages. These diseases may be conveniently dealt with under the following broad divisions :—(1) virus diseases, (2) protozoal diseases and (3) helminthic diseases.

I.—Virus diseases

(*i*) *Encephalomyelitis of horses.*—Other popular names given to this disease are cerebro-spinal meningitis, forage poisoning, Kansas horse disease, Kansas

Nebraska horse plague and Borna disease. The causative organism concerned in this disease is a filterable virus, and the condition can be experimentally produced by injecting blood from infected horses. Mules, cattle, deer, sheep and guinea-pigs may also be infected.

The symptoms associated with the disease are a rise of temperature, digestive disturbances, muscle spasms, difficulty in swallowing, dribbling of slimy urine, incoördination of movement, paralysis of head, neck and hind quarters [Kak, 1937]. Sometimes varying periods of excitement and coma are seen. In acute cases, hyperpyrexia sets in prior to death. The same or a similar disease has been known in India since 1872 and is quite common in several parts of the country.

The duration of the disease may last from one to twenty days and the mortality rate may be very high. While in some countries, this is a disease of summer and subsides with the approach of winter, equine encephalomyelitis of India on the other hand has been seen to be frequent in winter only.

Kelser [1933] proved that this disease may be transmitted among horses and mules by the mosquito, *Aedes aegypti*. There is also epizootic evidence to suggest that other species of the genus *Aedes* are also capable of transmitting the disease.

(*ii*) *Fowl pox.*—(Sore head). This is a very common disease of India affecting the bare parts of the head, comb, face and wattles of the poultry and is caused by a filterable virus. Fowls, turkeys, geese and pigeons have been known to suffer from the disease. It has been suggested that contagious epithelioma, chicken pox, canker, avian diptheria and roup are merely different manifestations of this disease, and are determined by one and the same virus.

It is both a contagious and infectious disease, usually, prevailing from the late summer to early winter, and young birds are more susceptible to the disease. The disease is characterised by wart-like nodules on the head and cheesy diphtheritic membranes in the buccal cavity with or without oculo-nasal discharge. The early symptoms are the appearance of small red pimples on parts of the head, especially the comb, the nodules varying in size from a pin-head to the size of a pea or larger. These nodules soon ulcerate, and on healing up they appear as dark scab-like masses. When dried up the scab ultimately drops, leaving the characteristic scar. The disease runs for three to six weeks [Kaura and Iyer, 1936].

It has now been experimentally proved that fowl pox is carried by mosquitoes and in recent years Kligler and his collaborators [1929] have shown conclusively that *Culex pipiens* (allied to the common *Culex fatigans* of India) and *Aedes aegypti*, a widely known Indian species, are capable of transmitting the disease to healthy susceptible birds after a feed from an infected comb, the infectivity in the mosquitoes lasting for fourteen days or more. More recently Brody [1936] also found that the disease may be transmitted by mosquitoes.

II.—Protozoal diseases

(*i*) *Buffalo malaria*.—Sheather in 1919, for the first time discovered a case of malaria among some experimental buffaloes at Mukteswar which were brought from the plains. The affected animal exhibited a fluctuating temperature rising upto about 40°C., the lowest recorded was 35°C., and the animal was very much depressed before death. The malaria parasite, *Plasmodium bubalis*, was recorded from the peripheral circulation of the buffalo.

Since this discovery buffalo malaria has been encountered repeatedly by veterinary workers in India, and it appears possible that a certain amount of bovine malaria also exists in parts of this country. These facts have bestowed a special vectorial importance to mosquitoes as they can be the only possible group of insects concerned in the spread of the disease.

(*ii*) *Avian malaria*.—The discovery of the life-cycle of the malaria parasites in the bird as early as 1898 by the pioneer work of Ross has the historic importance of opening up the comparatively new field of human malariology. Ross was able to establish for certain that the transmission of the malaria parasites, *Plasmodium praecox*, in the birds he studied was effected by the common domestic mosquito, *Culex fatigans* [Wenyon, 1926].

Subsequent workers have discovered more parasites from other birds, and new lights have been thrown upon our knowledge of malaria transmission by mosquitoes. Thus very recently Huff [1935] has observed that the avian malaria parasites, *Plasmodium cathemerium* of the canaries can develop not only in Culex but in a species of Aedes mosquito, *Aedes sollicitans*. Bruce Mayne [1928] again has been successful in experimentally transmitting avian malaria amongst sparrows through an anopheline species, *Anopheles subpictus*.

III.—Helminthic diseases

(*i*) *Heart worms of dogs*.—Of the helminthic conditions transmitted by insect vectors, the heartworms or filariasis of the dog may be considered first. This condition is brought about by the presence of small whitish filarial worms, *Dirofilaria immitis* in the blood of the dog.

The symptoms present in the dog in this diseased state are variable, and a definite diagnosis depends on microscopic examination of the blood smears of the animal. It is generally associated with lack of endurance, rough coat, lack of general condition, and a lazy attitude. In an advanced case extreme weakness, progressive anaemia, chronic indigestion accompanied by ascites and dropsical swellings may be noticed. In some cases dyspnoea and cough follows ; ordinarily the dog in such a state dies quickly. In a mild attack, the affliction may be overlooked but the affected dog gradually deteriorates in health, the parasitic condition brings forth a degenerative change in the blood system and the dog becomes predisposed to attacks of various other diseases.

The adult heartworms live in the right cavity of the heart or in large blood vessels, and their larvae appear in the peripheral circulation. From this latter situation the larvae are passed into the body of the Culex mosquito while feeding on the blood of an infected dog and here the worms mature. The worm is then transferred again to its vertebrate host, the dog, while the mosquito subsequently feeds on it. About eight species of mosquitoes are known as intermediate hosts of the worm [Hayes, 1933].

(*ii*) *Equine microfilariasis.*—Microfilariae have been often recorded in the blood of horses by various workers in India and abroad but their exact pathogenic significance is far from clear. Datta [1938] has recently shown the pathological effects of the different forms of helminthiasis, and the amount of debility and histological lesions, both internal and external, the different microfilarial worms may produce. Thus *Lichen tropicus* of horses producing on the skin superficial lesions of an irritable, papular and scurfy nature, as also Dourine-like plaques and the frequently recorded recurrent opthalmia in horses are shown to be due to different forms of microfilariae.

These larval forms have often been found in the peripheral blood of horses experimentally infected with surra, and the experience that the helminthic condition is not infrequently associated with trypanosomiasis, relegating this infection to a secondary position, has also been recorded by some [Sen, 1931].

Whatever the extent of damage owing to microfilarial infection in horses may be there is hardly any doubt as to the worms being transmitted from animal to animal by the mosquitoes which abound in the stables. Mules and bovines are also known to exhibit similar microfilariae in their blood and the mosquito-transmission theory is equally applicable to them.

Prophylactic measures

There is thus a great deal of suffering and damage in the animal world accountable to the depredations of the different mosquitoes, many of which would seem to be preventible if only suitable protective methods to avoid the animals being attacked by the mosquitoes are adopted. This of course, is a great task in itself; besides, the adoption of the suggested precautionary measures is likely to bring about a clash with human interest as the malariologists in some regions are used to taking advantage of this attractivity of mosquitoes to animals, especially the cattle, in protecting their own charges. The malariologists often advise building suitable cowsheds near human habitations in order to divert the mosquitoes from man to cattle, and thereby reduce the malariousness of a place. It has been seen in many places that animal houses properly built serve as effective screens to keep human population free from anopheline attacks.

But it would not be difficult to find out a *via media* out of this conflict, and whatever the difficulty be, prophylactic measures against mosquitoes deserve consideration in the hands of people interested in the welfare of animals. The most

desirable method in this direction appears to be the screening of the stables and animal byres with fine wire-netting. The provision of swing doors to these will be an additional improvement and the animals should be protected from mosquitoes from dusk till dawn.

But as the average stock-owner is likely to find the screening method an expensive affair, other cheaper methods to reduce mosquito nuisance, such as (1) fumigating the animal sheds before sunset when the animals are not in, by burning benzoine gum which produces intense smoke for a sufficiently long time in closed doors, (2) arranging of proper ventilation of the sheds so that the mosquitoes would be disturbed by the breeze, (3) painting the roof and walls white or simple white-washing the sheds and (4) proper cleaning of the sheds including removal of cobwebs hanging from the roof and walls as these provide suitable resting places of the mosquitoes, may be conveniently adopted.

So far prophylaxis against winged mosquitoes has been discussed. But these insects can also be very appreciably and more effectively controlled by destroying them in their earlier stages passed in water, through proper filling or draining of the water-collections of the neighbourhood, whenever possible, thus removing their breeding grounds, or by the application of some suitable larvicides such as kerosene or any crude petroleum oil on their breeding places to destroy their early stages. In fact anti-mosquito measures are essential for the betterment of Indian live-stock, not only from the point of view of checking the diseases that might be borne by mosquitoes but also in order to improve the general condition of the live-stock.

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PREPARATION OF TURMERIC FOR MARKET

A NEW POLISHING MACHINE

BY

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Turmeric (*Curcuma longa*), like most farm produce, requires a good deal of preparation before it is ready for market. After the rhizomes are dug out of the ground they are boiled in tubs and spread out on the ground to dry in the sun. They are then subjected to a cleaning process in the course of which the rootlets and scale and any remaining particles of soil are rubbed off. From the rough-coated, dirty brown condition, the rhizomes are transformed to a smooth, bright yellow, in which form the turmeric is ready for the market. This cleaning process is known as polishing.

The usual method of polishing in Madras Presidency employs a bamboo basket which is suspended waist high by four ropes from an overhead pole or branch of a tree. The basket is partly charged with fifteen to twenty lb. of boiled and dried turmeric, covered with a sack, and vigorously shaken backwards and forwards in a a short jerking motion by two men who stand facing one another with the basket between them. The shaking is continued until the turmeric in the basket is rubbed clean of all rootlets and scale, and takes on the required degree of polish and the attractive bright yellow colouration. Sometimes a few rough stones are added to the charge of turmeric to augment the polishing action. A similar method makes use of a wooden box which is charged with the turmeric and a few stones and shaken on the ground. In some parts, the turmeric is put in an iron picottah bucket and trodden with the feet. But these indigenous methods are slow and laborious and, often, due to their poor effect, the colour has to be brought up afterwards by an application of the yellow, powdered turmeric.

A much improved method of polishing, which has been evolved by the Agricultural Department, employs a horizontally mounted barrel of expanded metal, two feet long by three feet diameter, provided with a handle at either end for rotation by two men. The barrel or drum takes a charge of about seventy lb. of boiled and dried turmeric which is polished in seven to ten minutes at the normal working speed of thirty revolutions per minute of the drum. The turmeric is cleaned and polished as it rolls on the expanded metal during the rotation of the drum. The expanded metal by itself would allow the small rhizomes or finger turmeric

to fall out of the drum or become stuck in the mesh of the metal. The expanded metal is, therefore, covered on the outside with a tight wrapping of woven wire which is small enough in mesh to retain the finger turmeric, and at the same time large enough to allow the dust and dirt and rootlets to escape during the operation of the drum. When polishing is complete, a door, which extends the full length of the drum, is removed, and the entire charge of turmeric falls out in a few seconds into a sack or basket which is placed on the ground under the drum ready to receive it.

The machine is illustrated in the accompanying photograph. Plate XLV, Fig. I shows the machine being charged. Bulb turmeric before and after polishing is shown in Plate XLV, Fig. 2.

The normal output of the machine is over one ton of polished turmeric per eight-hour day. In Coimbatore district, where extensive trials and demonstrations have been conducted throughout the last three turmeric harvesting seasons, the machine has shown a saving of from Rs. 2 to Rs. 3 per ton in the cost of labour for polishing. Moreover, the machine prepared produce, due to its superior finish and colour, commands a higher price in the market by Rs. 3 to Rs. 7 per ton. In addition, there is a considerable saving in time compared with any of the indigenous methods of polishing due to the machine's much larger daily outturn The average yield per acre of polished turmeric is about two tons.

The machine is of the simplest design, with nothing to get out of order, and robustly constructed to last for many seasons. Though primarily designed for operation by hand, it could easily be adapted for belt drive in central factories or other places where power is available The weight of the drum including axle and handles is 165 lb.

The cost of the machine, excluding the wooden posts, is about Rs 35. Suitable pieces of timber for the posts may be available on the farm or purchased cheaply in the nearest bazaar. During the last two seasons, machines have been made available, in the turmeric growing centres, for hire to growers, and a keen demand for them has arisen at the rate of As. 8 per day charged by the Department.

Fig. 1 Charging the machine

Fig. 2 Bulb turmeric before and after polishing

NOTES

PUNJAB FORESTRY NOTES

(Issued by the Chief Conservator of Forests, Punjab, Lahore)

THESE short notes contain useful articles on popular subjects of the nature of the 'Effect of Forests in Preventing Floods', handling nursery plants in forests, recommendations of the Erosion Conference, introduction and performances of exotic plants of economic value, etc. Some notes give description of plants commonly growing in the jungles and rural areas of the Punjab, a knowledge of which will prove equally useful to the agriculturist and the lay-man. These notes are free and the useful information contained in them is intended for wide distribution. The articles are contributed by the officers of the Department and, therefore, the information is reliable.

Note No. 2. deals with *karir* (*Capparis aphylla*)—a plant with which every Punjabi conversant with the wild vegetation of moffussil areas is well acquainted. The economic uses of the plant are well known but information about methods of planting, growth and development is not commonly known. This is contained in the note. Similar information on *phulahi* (*Acacia modesta*, Wall), is contained in Note No. 3. Note 4 gives a description of *harar* (*Terminalia chebula*) cultivation in the Punjab. There will hardly be found a Punjabi who is not acquainted with the utility of the fruit of this tree but it is equally true that except for the very few who may be actually growing it, a great majority are unacquainted with the tree and its performances. These useful pamphlets give a detailed description of different aspects of such plants.

This attempt on the part of the Forest Department of the Punjab to disseminate general knowledge about common plants and related practices of economic value amongst the educated classes of the Punjab is commendable and worthy of emulation by other departments. [R. L. S.]

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REPORT ON PNEUMATIC TYRED CARTS AND OTHER EQUIPMENT

(By Professor Robert Rae. Published by the British Rubber Publicity Association, 19, Fenchurch Street, London, E. C. 3)

Special Series Bulletin A

THIS is a report of the tests carried out with rubber tyred carts and other equipment at the University of Reading Farm at Sonning-on-Thames in 1937. The Council of Rubber Growers' Association co-operated in these tests and supplied

the carts and other necessary equipment. A comparison of farm carts running on pneumatic tyres with and without roller bearings and iron tyres showed that roller bearings did not make much difference and that pneumatic tyres reduced the draught over soft ground sufficiently to give a considerable saving in horse power. Dynamometer trials confirmed the generally accepted opinion that carts fitted with rubber tyres are much easier in draught and that, therefore, an increased load can be drawn without any increased strain on the horse. Practically all items of moving transport of any kind on the farm, for instance long cart, box cart, water cart, low-loading cart, long-bodied-Scotch cart, tractor trailer, four-wheeled lorry and hand water carriers, wheel and sack barrows, etc., were fitted with pneumatic tyres and tested. All these trials have given such satisfactory results that it is not now desired to revert to any other form of tyre. No trouble of any kind was experienced with any of the pneumatic tyres.

The note is illustrated with different types of equipment which were fitted with pneumatic tyres and tested. The information contained in the note will be found useful by various experimentors who are conducting similar trials on the use of pneumatic tyres on different farms in the country. [R. L. S.]

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BULLETIN OF THE INDIAN CENTRAL JUTE COMMITTEE

(1, Council House Street, Calcutta)

The Bulletin is a monthly publication and contains information on such aspects of the jute crop which have a bearing on its consumption in different countries. It contains reports from the Argentine Correspondent of the Jute Committee, the Commercial Correspondents of the Director General of Commercial Intelligence and Statistics, India, report of the Indian Trade Commissioners on imports, exports, stocks and consumption of jute, the conditions of the jute industry in outside countries and the use of jute substitutes, etc. It also contains relevant jute statistics compiled from different publications, figures of production, manufacture, export and stock of jute in India and a monthly report on the progress of the schemes in operation under the control of the Jute Committee.

The most important information contained in the Bulletin Nos. 5 and 6 (August and September 1938 issues) may be summarised below :—

Jute is grown in Brazil, Iran and French Indo-China and attempts to grow it in Siam have also proved successful. In Madagascar sacks have been made from a fibre akin to jute and similar attempts are likely to be made soon in French Indo-China with another substitute fibre.

The Government of the United States of America has decided to encourage the use of cotton bale coverings instead of jute ones and their Post Office

Department has started using cotton twine in place of jute. A similar move for using cotton in bale coverings is also afoot in the Argentine.

Paper bags have displaced jute sacks in certain cases such as handling of cement, lime, salt, etc. The Argentine annually imports nearly 5,000 tons of kraft paper for similar requirements. In Australia the erection of grain elevators is making good progress and it is expected that a large number of them will be ready for handling the 1939-40 crop.

The Jute Committee has been successful in collecting the actual stock figures of the raw jute held by the Indian Mills and it amounted approximately to 29·3 lacs of bales on 30th June, 1938. Stocks of jute and jute goods held by some consuming countries such as New Zealand, the Netherland Indies, Celebes, the Philippines, Germany, Hungary, Rumania and the Argentine have also been recorded in the Bulletin.

ABSTRACTS

Studies in Indian fibre plants. V. Phyllody and some other abnormalities in the flower of sunn-hemp. R. D. Bose and S. D. Misra, (*Ind. J. Agric. Sci.* **8**, 417).

Phylloid flowers in sunn-hemp have been observed at Pusa and show the transformation of some or all floral whorls into greenish leaf-like structures. Twelve abnormal types of phylloid flowers have been recognized and are briefly described; all of these cause complete sterility of the plant. Two or more abnormal types of flowers are sometimes found on the same inflorescence but the same plant does not bear normal flowers on some branches and phylloid flowers on others.

Proliferation of parts has been observed in some phylloid flowers. Adherence of vegetative shoots formed by the transformed stamen and the transformed carpel has also been observed. A case of fasciation has also been observed recently.

That phyllody in sunn-hemp may be due to a virus is suggested by the fact that the condition was transmitted by grafting normal scions on phylloid stocks and *vice versa*. (*Authors' abstract*).

A note on the occurrence of chlorophyll deficiency in *Gossypium arboreum* J. B. Hutchinson and Bhola Nath. (*Ind. J. Agric. Sci.* **8**, 425).

A chlorophyll deficient seedling type which appeared in a cross between Malvi 9 (*G. arboreum* var. *neglectum* forma *bengalensis*) and a strain of *G. arboreum* var. *cernuum* is described. The deficient type is shown to be a simple recessive to the normal green. It is found to resemble the deficient type obtained at Coimbatore from X-rayed material. The origin of the type is traced to a gene mutation in the Malvi 9 parent. (*Authors' abstract*).

A note on seed-setting and seed-germination in certain sugarcanes. N. L. Dutt, M. K. Krishnaswami and K. S. Subba Rao. (*Ind. J. Agric. Sci.* **8**, 429).

The seed germinations of over forty varieties were studied for five to seven seasons. Varieties like P. O. J. 2725 gave uniformly high germinations, while *S. officinarum* varieties such as Vellai, Chittan, etc., gave consistently low germinations. The *S. spontaneum* forms topped the list. A judicious combination of *S. officinarum* and *S. spontaneum* blood in Co. 419 and Co. 421 has resulted in these varieties giving seed of high germinating capacity.

The attempt to improve germination by chemical means was not successful.

While a certain amount of influence of the pollinating parent was evident, the high or low germinations seem to depend more on the inherent capacity of the female parent.

The securing of desirable type of seedlings appears to be intimately connected with inter-varietal rather than inter-specific crosses.

Seeds of sessile spikelets gave more germinations than those of pedicelled ones in all the cases examined, including *S. spontaneum*.

A high positive correlation was noticed between the thickness of the cane and the length as also width of the seed. (*Authors' abstract*).

A note on the use of sub-acetate of lead in the clarification of sugarcane juice for the estimation of reducing sugars by the potassium ferricyanide method. K. L. KHANNA and S. C. SEN. (*Ind. J. Agric. Sci.* **8**, 441).

THE Fehling's method for the estimation of glucose in cane juice is now widely accepted although the necessary use of sodium phosphate filtrate makes it laborious and time-consuming, so that where large rounds of analyses have to be completed within the course of each day, as is the case in Sugarcane Research Laboratories, an accurate yet quick method is a desideratum.

One such method has been found in the direct use of lead sub-acetate filtrate for titration against one per cent alkaline potassium ferricyanide solution. The method which qualifies the amount of lead sub-acetate to be used for clarifying the original cane juice (two to three grms. for 150 c. c. of cane juice) gives results closely corresponding to those that are obtained with sodium phosphate filtrate by Fehling's and ferricyanide solutions. The advantage is evident as both the estimations for sucrose and glucose can be done from the same filtrate. (*Authors' abstract*).

Denitrification in the presence of sugars. S. V. DESAI and FAZAL-UD-DIN. (*Ind. J. Agric. Sci.* **8**, 447).

PHOTO-DENITRIFICATION of potassium nitrate and sodium nitrite in the presence of some carbohydrates has been studied. It has been found that the reduction of potassium nitrate is not affected by the concentration of glucose present. The denitrification of sodium nitrite is much accelerated in the presence of carbohydrates, and is independent of the nature of carbohydrate used. The decomposition of nitrite is more rapid than that of nitrate. Ammonia is also formed during reduction. The oxygen of the air is not essential for bringing about denitrification. The oxidation of glucose to carbon dioxide, water and acids, and other non-saccharine substances is greater in the presence of sodium nitrite than in its absence. (*Authors' abstract*).

Studies on quality in rice. I. Effect of milling on the chemical composition and commercial qualities of raw and parboiled rices. V. Subrahmanyan, A. Sreenivasan and H. P. Das Gupta. (*Ind. J. Agric. Sci.* **8**, 459).

As the result of parboiling, the total nitrogen content of hulled rice is increased slightly (to the extent of 2 to 3 per cent) while the phosphorus content remains practically unaffected. The high nitrogen content of parboiled (hulled) rice is due to a part of the nitrogen in the husk being fixed on to the grain during parboiling.

Only insignificant quantities of nitrogen or of phosphorus pass into the steep water used prior to parboiling. Variations in the time and temperature of steeping and of steaming or boiling during parboiling of paddy does not result in appreciable changes in the nitrogen or phosphorus contents of the husk, huller bran and rice (kernel) of the paddy. On the other hand, these two factors do affect the colour and odour of parboiled rice. The colour is derived from the husk and the odour largely through fermentation during steeping. Both of these undesirable features can be reduced to a minimum by maintaining a continuous flow of the steep water, or, at any rate, changing it frequently.

Comparison of specimens of raw and parboiled rices milled to different degrees would show that with the same degree of milling, parboiled rice is usually richer in nitrogen and in phosphorus than raw rice. With increased milling, the difference tends steadily to diminish until at 10 to 15 per cent, the nitrogen and phosphorus contents are more or less the same.

Study of the distribution of nitrogen and of phosphorus in the germ (embryo), bran (pericarp) and endosperm fractions of the rice (raw) grain has shown that more than 50 per cent, of the phosphorus and 20 per cent of the nitrogen are localised in the former two fractions, which are generally completely lost during milling. On parboiling, a part of the nitrogen and of the phosphorus present in the germ is transferred to the endosperm. Examination of the outer layers of the endosperm of the rice grain has shown that, even in the endosperm, the protein and mineral constituents are concentrated in the outer layers and decrease rapidly towards the interior.

Parboiled rice has a higher ash content than raw rice polished to the same extent. Both raw and parboiled rices contain, however, only traces of these mineral constituents when polished to beyond 10 per cent of their original weight.

On washing repeatedly, parboiled rice, whether polished or unpolished, loses less of nitrogen or of phosphorus than raw rice polished to the same extent. In a like manner, comparatively less of water-soluble constituents pass out in the 'rice water' on cooking parboiled rice.

The milling quality of rice varieties is greatly improved by parboiling. Between 30 and 100 per cent more of head rice is yielded with the different varieties. The different conditions relating to steeping and steaming affect the yield of head rice both before and after milling. Speaking generally, soaking for forty-eight to seventy-two hours at 35°C. followed by steaming at fifteen lbs. for fifteen minutes gives uniformly satisfactory results. Steaming for longer periods results in increased breakages. The

significance of the foregoing observations in relation to the comparative nutritive values of raw and parboiled rices and the nature of the factors responsible for the colour of parboiled rice are discussed. (*Authors' abstract*).

A study of the microbiological conditions existing in rice soils. PRAN KUMAR DE and NRIPENDRA MOHON BOSE. (*Ind. J. Agric. Sci.* **8,** 487).

THE investigation was undertaken to study the changes in the numbers and in activities of different groups of micro-organisms in soils under conditions similar to those occurring in the rice fields of India ; and also to ascertain to what extent the microbiological conditions of a soil, dried after a long period of water-logging, may differ from those obtaining under dry cultivation.

The results showed that the activities of most of the micro-organisms remained suppressed during the water-logging period, particularly at an early stage, but at a later period, and also when water-logged soils were dried, the activities again increased. When the soils were kept at high temperature (50-54°C.) without adjustment of moisture (conditions corresponding to those occurring in the rice fields in summer) total numbers of bacteria and fungi, and the nitrifying capacity decreased considerably. *Azotobacter* and the nitrogen-fixing capacity, however, were not much affected by these conditions.

Previous water-logging of a soil for a long period did not affect the activities of ammonifying and nitrifying bacteria, when it was subsequently dried, but its effect on some of the micro-organisms was depressing. (*Authors' abstract*).

The problem of vitamin-A deficiency in the diet of farm animals. K. C. SEN and P. A. SESHAN. (*Ind. J. Vet. Sci. & Anim. Husb.* **8,** 168).

THIS paper attempts to summarise the present position of avitaminosis-A so far as it relates to the practical feeding of farm animals.

Cereals, grain feeds, vegetable oils and oil-cakes are found to be poor sources of carotene (the precursor of vitamin-A) which is generally associated with the pigments of all plant material.

Green young forage plants are, however, found to be satisfactory sources of carotene for animals.

The vitamin-A requirements of rats, dogs, poultry, swine and cattle are discussed. The excretion, storage and depletion of the vitamin-A reserve of animals through reproduction and milk are described.

The point is stressed that the provision of suitable green feeds or pasture land is the only practical method of supplying the carotene requirement of farm animals. In this connection, the importance of preserving the vitamin-A potency of green plants when converted into hay or silage has also been emphasised.

The existence of avitaminosis-A in a mild form under the ordinary conditions of stock feeding in India and the need of rectifying this condition are also considered. (*Authors' abstract*).

On the nuclear structure of *Babesia bigemina* (Smith and Kilbourne). H. N. RAY. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 183).

IN 1930, Dennis from America described the structure of the nucleus of *Babesia bigemina* and since he noted the presence of blepharoplast in this organism he suggested its affinity with the Flagellate. According to him *Babesia* is of flagellate origin, and even if sporozoan, indicative of the polyphletic origin of that group.

In this article the author has described the result of his studies on the distribution of chromatin in the nucleus of the Indian strain of *B. bigemina*. The nuclear chromatin, as revealed by Feulgen's reaction, was found chiefly to be confined to the apical portion of the parasite. It consisted of a circular row of fine chromatin granules with a central karyosome. The nuclear structure presented varied appearances with different fixatives and stains. No evidence of a blepharoplast was however forthcoming. (*Author's abstract*).

Rhinosporidiosis in bovines in the Madras Presidency with a discussion on the probable modes of infection. M. ANANTNARAYAN RAO. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 187).

THE author notes that the number of cases of rhinosporidiosis in animals, reported from various parts of the world, is small and those reports refer to three equines in South Africa and one in Uraguay. A few years ago the disease affecting two bullocks, one cow and one pony was recorded in the Madras Presidency. Since then the disease has been diagnosed in eighteen bullocks and one pony in the same province. It would seem that rhinosporidiosis in bovines has been reported so far only from Madras Presidency and from no other part of the world.

It is observed that in animals, just as it is in a large majority of human beings, the lesions are found in the nose, and the presence of a trauma in the nose appears to be necessary for the development of the lesions. In the Madras Presidency the disease is found affecting both men and animals in certain districts. *Rhinosporidium* has not been reported from animals from North India, though it has been reported to affect the human beings in certain provinces.

The author has discussed in his paper the resemblance in the histopathology, etc., of the lesions in man and animals and suggests that the causal organisms may be identical in them. While describing the contents of the asci of *Rhinosporidium* the author suggests that the large spores may be analogous to seeds of plants and are meant to complete their biological destiny outside the animal body. He suggests that those spores may germinate in manure into a saprophytic fungus whose end products are

infective to healthy animals, since direct transmission with the large spores from the lesions is not possible. It is also suggested that the small sized spores, which were hitherto considered as undeveloped ones are really not so, but they are meant to continue the parasitic phase in the tissue of the host.

Some amount of success is claimed in cultivating the fungus in sterile cow dung and the author suggests that the infection to man and animals may be through dust raised while ploughing fields manured with bovine dung, since a large number of cases of rhinosporidiosis are met with in men and animals engaged in agriculture. The probability of the infection being water borne is also discussed. The paper is illustrated with some photomicrographs of lesions, etc., from bovines and equines. (*Author's abstract*).

Studies on a natural outbreak of pigeon-pox. R. L. KAURA and S. GANAPATHY IYER. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 199).

A NATURAL outbreak of pigeon-pox occurred in a stock of healthy pigeons at Mukteswar Institute and the source of infection was not traceable. The causative agent was demonstrated to be a filterable virus and has been maintained by passage through pigeons. This appears to be the first recorded outbreak in India.

Immunological tests of the virus isolated, indicate certain degree of antigenic variations from the English strain of pigeon-pox virus, although both are similar on grounds of pathogenicity and their capability to protect fowls against fowl pox.

Preliminary complement fixation tests showed that complement fixing bodies were rarely demonstrable in the sera of healthy as well as pigeon pox immune birds. (*Authors' abstract*).

A new trematode—*Prosthogonimus indicus*, n. sp., occurring in the oviduct of Indian fowls, with remarks on 'Prosthogonimiasis'. H. D SRIVASTAVA. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 213).

HIERONYMI and Szidat, 1921, were the first to report serious losses amongst poultry due to a fluke disease caused by *Prosthogonimus pellucidus*. Subsequently not only several cases of the disease—Prosthogonimiasis—have been reported but also a number of new species of the genus has been described. The genus is now considered to be the most pathogenic trematode of poultry, specially in low-lying and water-logged areas. The worms, which usually live in the Bursa fabricii, enter the oviduct in laying birds and are responsible for producing acute inflammation and consequent production of soft-shelled eggs and discharge of albumen. There is a sharp decline in the production of eggs. Owing to irritation retroperistaltic movements are set up in the oviduct causing broken yolk, albumen, parasite and parasite material to enter the peritoneal cavity thus producing acute peritonitis. In this paper the author describes a new species of the genus—*P. indicus*—which occurs in the oviduct of Indian fowls. The

validity of the new species has been established. The history, symptoms, diagnosis, treatment and prevention of the disease have been discussed. The Indian snipes are suspected to be the reservoir hosts of the parasite in this country. (*Author's abstract*).

Rhinosporidiosis in Equines. LAKSHMI SAHAI. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 221).

In this paper the author records the discovery of another case of Rhinosporidiosis in equines in India in a country-bred mare at Bargarh in the Sambalpur district of Orissa, the first case having been recorded by Krishnamurti Ayyar in Madras in 1932.

The animal which had a noisy breathing and blood-stained mucous discharge from one of the nostrils, on examination, showed a small cauliflower-like growth about one inch long and half inch thick situated in the anterior part of the nasal chamber slightly obstructing the passage.

On histological examination the growth revealed all the essential features of *Rhinosporidium* recorded by Krishnamurti Ayyar in the case from Madras.

Underlying the covering stratified squamous epithelium, in the superficial layers of the highly vascular subjacent connective tissue, were present numerous cysts or sporangia in various stages of development, the fully mature ones being seen to increase in size, approach the surface as they grow and burst to discharge the spores.

It is suggested that further systematic search may perhaps reveal the presence of many more cases in other parts of India, a subject of some importance in view of the close connection between and possible identity of *Rhinosporidium equi* and *Rhinosporidium seeberi*, the causal parasite of Rhinosporidiosis in man. (*Author's abstract*).

The occurrence of *corynebacterium equi* in a she-buffalo. V. R. RAJAGOPALAN and V. R. GOPALAKRISHNAN. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 225).

CORYNEBACTERIUM EQUI has been recognised by several workers as a cause of pneumonia in young equines. It has not so far been recognised as occurring in any other species of animals. Its occurrence in pyometra, following abortion in a she-buffalo, is therefore recorded in this article. Its identity with *Corynebacterium equi* has been proved by morphological, cultural, biochemical, serological and biological tests. The probability of its being an etiological factor of either abortion or of post-abortion pyometra is discussed. (*Authors' abstract*).

Studies on the Helminth parasites of Indian poultry. Part II. The occurrence of gapeworm in fowls. H. D. SRIVASTAVA. (*Ind. J. Vet. Sci. & Anim. Husb.* **8**, 239).

The occurrence of gapeworms *Syngamus trachea*, has been reported from a number of domestic and wild birds from various parts of the world. However, the parasite

has not been previously recorded from an Indian host. The author recovered four specimens of this parasite from the trachea of two chicks examined at Bareilly in 1935. Remarks on the 'gape' disease, its treatmnt and prevention are given. The occurrence of gapeworms in Indian snipes, which may serve as carriers is also recorded. (*Author's abstract*).

Dissemination of Anthrax infection through dirty stagnant pools. R. N. NAIK. (*Ind. J. Vet. Sci. & Anim. Husb.* **8,** 243).

ANTHRAX which is an enzootic disease of domestic animals in various parts of India is not of uncommon occurrence during the summer season when green grazing is not available, but the source of infection during this season was not known. Investigation was, therefore, carried out in certain outbreaks of Anthrax which occurred in cattle during the summer season in 1937 in the Ratnagiri District with the results that dirty stagnant pools formed in the river bed were found to be the actual source of infection. A virulent strain of *B. anthracis* has been recovered from a sample of water from one of such pools after subjecting it to a biological test. (*Author's abstract*).

A new parasite of the Family Acanthocolpidae Luhe 1909, from an Indian host. H. D. SRIVASTAVA. (*Ind. J. Vet. Sci. & Anim. Husb.* **8,** 247).

IN this paper a new species of the genus *Echinostephanus* has been described. An interesting feature of the genus is the opening of the intestinal caeca into the excretory bladder. The Indian form resembles the type species in most of its features but it can be easily distinguished from it by the number and the arrangement of its cephalic spines. (*Author's abstract*).

The occurrence of an unrecorded filarid nematode, *Onchocerca cervicalis* Railliet and Henry, 1910, in the Ligamentum nuchae of horses in India. H. D. SRIVASTAVA. (*Ind. J. Vet. Sci. & Anim. Husb.* **8,** 249).

RAILLIET and Henry in 1910 described *O. cervicalis* from the ligamentum nuchae of equines in France. Subsequently the parasite has been reported from several countries—Australia, England, United States of America and Africa. It has been suspected to be the cause of poll evil, fistulous withers and Lichen tropicus. The occurrence of the parasite in Indian hosts has not been previously reported. In this paper the author records the finding of the worm in the Ligamentum nuchae of three horses suffering from Lichen tropicus. (*Author's abstract*).

The occurrence of *Paragonimus westermani* in the lungs of cats in India. H. D. SRIVASTAVA. (*Ind. J. Vet. Sci. & Anim. Husb.* **8,** 255).

THE well-known lung fluke, *Paragonimus westermani*, originally described from the lung of a tiger, is now known to occur in the lungs and rarely in the brain, spinal

cord, liver, intestine and other organs of man, pig, dog, cat, goat, cattle and wild carnivores in several parts of the world. The only record of its occurrence in an Indian host is by Rao who in 1935 reported it in two dogs from Madras. In this paper the author reports the occurrence of this parasite in the lungs of an Indian cat. The finding of the eggs of this parasite in the cardiac muscles of a dog is also recorded. (*Author's abstract*).

The following abstracts have been received from the President, Forest Research Institute, Dehra Dun, and are published here as they are of interest to agricultural workers :

Indian Tephrosia sp. as a source of rotenone. S. KRISHNA and T. P. GHOSE. *Current Science* **45**, March 1938.

ROOT bark of *Tephrosia candida* has been found to contain 0.35 per cent and the seeds 0.5 per cent of rotenone. The leaves also contain rotenone as indicated by colour test. Root bark of *Tephrosia purpurea* showed presence of rotenone (less than 0.3 per cent colour test positive) (*Authors' abstract*).

Stone bunds in erosion control. R. M. GORRIE. *Ind. For.* LXIV (3) : 149-50. 5 pls. 1938.

DESCRIBES the wrong and right ways of constructing rough stone bunds for control of gullying, special note being made of the best spacing and proper contouring of the top of the bunds. (*M. V. Laurie*).

REVIEWS

Erosion and Soil Conservation. By G. V. Jacks and R. O. WHYTE. Bulletin No. 25. Herbage Publication series. Imperial Bureaux of Pastures and Forage crops, Aberystwyth, Great Britain. Pp. 206. Price 5*s*.

THE authors have done very valuable service by compiling an up-to-date account of the present position of soil-erosion in various countries which are seriously affected by it. Not only has the existing literature on the subject been collected and compiled, but special articles have been obtained from various official and non-official workers throughout the world and have been recorded.

The bulletin first deals with the four important countries, *viz.*, Italy, Cyprus, Turkey and Palestine, bordering the Mediterranean. These countries are in a most advanced stage of erosion and their respective Governments have started taking steps for Land-reclamation in the eroded areas. The next section deals with the Soviet Russia. Some of the Physico-chemical characteristics of the erosive and non-erosive soils have been investigated in that country but no practical steps have been taken to prevent soil-erosion.

The practical measures for prevention or control of soil-erosion adopted in different parts of India, are described in a separate section. Ceylon was pioneer country in recognizing the significance and consequences of soil-erosion and several ordinances were passed to prevent misuse of land and to control soil-erosion. The East Indies, the Philippine Islands and Siam receive brief notice. Some of these territories, on account of their geological formations and climatic peculiarities, are subject to serious erosion. Soil erosion in China is based upon the material collected by Lawdernilk and Thorp. Both sheet and gully erosion have progressed very far in many districts. Numerous difficulties of the cultivators and of the Government are mentioned and the importance of tackling the problem as a whole on a national scale has been brought out.

Japan is described as an example of a country where soil-erosion is effectively checked by various methods, regardless of cost. The soils and topography of Japan are highly erodible under torrential rainfall. The Agricultural Department has spent up to ten times the value of the eroding land to control erosion. Reforestation, artificial terracing on steep slopes and grass sod are some of the effective methods adopted to check erosion in Japan.

The soil-erosion problem in different parts of Africa has been discussed in detail. There erosion has transformed parts of South Africa's richest pastoral country into semi-desert. In 1923, the Drought Investigation Commission pointed out that soil-erosion could account for the disastrous effects of drought. Construction of dams was adopted till the end of 1936.

In Rhodesia, contour terracing on ridges has been done, thus protecting more than forty-five thousand acres of land. Scientific investigation on erosion, propaganda, and advisory services are some of the steps taken to combat this trouble in East Africa.

Soil-erosion work in the United States of America occupies a prominent position in the bulletin. The United States is the only country where at even an approximate estimate of the drainage by erosion has been made. The Department of Agriculture in 1933 created special organization called the Soil Conservation Service to deal effectively with this important problem. They completed a preliminary reconnaissance erosion survey in 1934 and divided the whole area into different classes according to the extent and the type of erosion, *i.e.*, sheet-erosion, gully-erosion, wind-erosion or a combination of two or more of these types. The work is carried out in four main divisions, *viz.*, (1) Conservation Operations, (2) Co-operative Relations and Information, (3) Research and (4) Surveys. Research carried out on Soil Conservation Experiment Stations for a number of years has yielded useful results of great importance. Laboratory work has also provided information about factors influencing erosion. Advantage is taken of all the available information in carrying out projects for checking erosion and conserving soil with the co-operation of the farmers. The Department undertakes the survey and prepares a cropping plan with proper rotation of crops field by field.

The Conservation Service helps the formation of Farmers Clubs or Associations which pool their resources for obtaining adequate equipment and for carrying out co-operative projects of contour terracing, strip cropping on fields, check dams and revegetation in waste land and reforestation of woodlands which have been destroyed by over-grazing. The Tennessee Valley Authority is an example of a most important organization for the regional reclamation of an area of about 40,000 square miles with a population of 2·5 millions. This organization has a very wide programme consisting of erosion control, navigation scheme, flood control, reforestation, resettlement of the population, electricity supply, the production of fertilizers and agricultural improvements. All these features are interdependent. The cost of the project is estimated at 350—400 million dollars and is expected to be completed in 1943. Several States have passed laws creating soil conservation districts which are empowered to establish suitable organizations for carrying out projects of soil conservation by controlling erosion on a co-operative basis.

In addition to the work of the Soil Conservation Service the Forest Departments handle their problems in such a way as to form part of a well considered land policy in which the local needs of shelter belts, fuel and timber reserves and grazing areas are integrated with local agricultural production, and also take into account the bigger issues of commercial timber production, flood control, game protection and recreation.

In Canada wind-erosion is very serious in the Prairie district while water-erosion is serious in Eastern Canada. Strip-farming, tree-planting and suitable forage-crops-cultivation are the remedies suggested against wind-erosion. For controlling water-erosion, listing, terracing and contour cultivation are found effective methods.

A brief account of soil-erosion occurring in the West Indies, Australia and the Fiji Islands is also given.

References to published literature in each country at the end of each section have enhanced the value of the publication.

Students of soil science will find the publication extremely useful as an authoritative reference book on the subject of soil-erosion. The book not only describes the numerous causes of soil-erosion and the factors influencing erosion but also contains an account of the various remedies successfully adopted for its control in different countries. The publication is recommended to all who are interested in agricultural lands directly or indirectly. [N. V. K.]

The Frame working of Fruit Trees. Occasional Paper No. 5 of the Imperial Bureau of Horticulture and Plantation Crops. By R. G. Garner and W. F. Walker. Pp. 19, bibl. 26. Price 1s.

THE authors set out briefly, but intelligibly, the results of practical orchard experiments in Tasmania, England and elsewhere, on methods of topworking and thereby changing the variety of fruit trees at will.

The method commonly accepted in the past has consisted—to put it somewhat crudely—in chopping off the top of the tree and inserting one or two grafts into the stump, or into not more than the two or three branches which remain.

The method which they describe consists essentially in the insertion of a very large number of grafts right out at the ends of all the smallest branches. The labour involved is very much greater but the return of the tree to productivity is also greatly accelerated and would appear to make the practice worth while.

Four ways of carrying out the operation are described, namely, stub-grafting, side-grafting, inverted ⊥ bark-grafting and awl-grafting. Clear line drawings greatly facilitate an understanding of the methods, while photographs showing an

apple tree immediately after treatment and another similar tree two years after treatment bearing five bushels of fruit, demonstrate the results which can be expected.

Possible difficulties, choice of grafting wax, costs and other practical points are all fully discussed.

"The Statistical Year Book 1935" and "Agricultural Statistics (1925-26 to 1934-35)" for H. E. H. the Nizam's Dominions. By Mazhar Hussain, M.A., B.Sc., Director of Statistics. Price Rs. 5 and Rs. 2 respectively.

The "Statistical Year Book" for the Dominions of H. E. H. the Nizam, which has just been published by the Director of Statistics of the State, is presented in its present form for the first time. The statistics which were contained formerly in 'Agricultural, Industrial and Trade Statistics' will be incorporated henceforth in the 'Year Book'. With the expansion of education, trade and industry, the need for up-to-date statistical information has increased considerably and the year book not only obviates the necessity of having to consult different publications of the various departments but contains figures not available in the usual departmental reports. In addition to statistics of other departments, a section is also devoted to Agricultural Statistics.

"Agricultural Statistics"—a separate issue—makes available a ready reference book to all interested in statistics of agricultural production in regard to food and raw materials. This information has been compiled in this manner for the first time and is to be revised quinquennially in future. The publication shows in detail the classification of the areas of the divisions and sets forth the acreage under each crop and its quantitative yield. Sources of irrigation, and the areas and crops irrigated are also stated. Statistics relating to Land revenue assessment; and live-stock, together with relevant charts and diagrams, are also incorporated.

Both books contain useful information. They can be obtained either from the Director of Statistics or the Government Central Press, Hyderabad—Deccan. [R. L. S.]

NEW BOOKS

On Agriculture and Allied Subjects

A Text-book of Geology. By P. Lake, M.A., F.G.S., formerly Reader in Geography in the University of Cambridge and R. H. Rastall, Sc.D., F.G.S., Fellow of Christ's College and Lecturer in Economic Geology in the University of Cambridge. 32 plates and 134 figures. (Edward Arnold & Co., 41 and 43, Maddox Street, London, W. 1.) Price 21*s*. net.

Elementary Microtechnique. A practical manual on cutting, staining and mounting sections of biological material. By Alan Peacock, M.Sc. (Edward Arnold & Co., 41 and 43, Maddox Street, London, W. 1.) Price 5*s*. 6*d*. net.

Practical Photo-Micrography. By J. E. Barnard, F.R.S , F. Inst. P., F.R.M.S., Director, Department of Applied Optics, National Institute for Medical Research and Frank V. Welch, F.R.M.S. Third Edition. (Edward Arnold & Co., 41 and 43, Maddox Street, London, W. 1). Price 21*s*. net.

Structural Geology with Special Reference to Economic Deposits. By Dr. Bohuslav Stoces and Charles Henry White. 700 illustrations. (MacMillan & Co., Ltd., London, W. C. 2.) Price 25*s*. net.

Plant Form and Function. By Prof. F. E. Fritsch, D.Sc. Ph.D., F.R.S., and Prof. E. J. Salisbury, D.Sc., F.R.S. 650 pages. 445 text-figures. (G. Bell & Sons, Ltd., York House, Portugal Street, London, W. C. 2.) Price 17*s*. 6*d*.

Ground Work of Biophysics. By G. M. Wishart, B.Sc., M.D., Gardiner Professor of Physiological Chemistry in the University of Glasgow. (G. Bell & Sons, Ltd., York House, Portugal Street, London, W. C. 2). Price 12*s*. 6*d*. net.

Food Planning for Four Hundred Millions. By Radhakamal Mukerjee, M.A., Ph.D., Professor and Head of the Department of Economics and Sociology, Lucknow University, India. (MacMillan & Co., Ltd., London, W. C. 2.) Price 7*s*. 6*d*. net.

The Air and Its Mysteries. By C. M. Botley, F.R.Met.Soc. Illustrated with many diagrams in the text and with sixteen plates. (Bell : York House, 6, Portugal Street, London, W. C. 2.). Price 8*s*. 6*d*. net.

The Origin of Life. By A. I. Oparin, Associate Director, Biochemical Institute, U.S.S.R. Academy of Science. Translation with annotations by Sergius Morgulis, Professor of Biochemistry, University of Nebraska. (MacMillan and Co., Ltd., London, W. C. 2.) Price 8*s*. 6*d*. net.

The Measurement of Linkage in Heredity. By K. Mather (Methuen's Monographs on Biological Subjects.) (London: Methuen and Co., Ltd., 1938.) Price 4*s*. 6*d*. net.

Everyman's Wild Flowers and Trees: Five Hundred of the British Wild Flowers, Trees, Shrubs, Grasses and Ferns. Described and illustrated. By Miles Hadfield. (London : J. M. Dent and Sons, Ltd., 1938). Price 6*s*. net.

The Modern Greenhouse : a New and Practical Guide to the Management of the Warm and Cool Greenhouse. By J. S. Dakers. (London, New York, Toronto and Melbourne : Cassell and Co., Ltd., 1938). Price 8*s*. 6*d*. net.

The Wasted Land. By Gerald W. Johnson. (Chapel Hill, North Carolina, University of North Carolina Press ; London : Oxford University Press, 1938.) Price 7*s*. net.

Gardens and Gardening, 1938. Edited by F. A. Mercer. (London : The Studio Ltd., 1938). Price 10*s*. 6*d*. net.

Cryptogamic Botany. Vol. I—Algae and Fungi. Vol. II—Bryophytes and Pteridophytes. By Gilbert M. Smith, Professor of Biology, Stanford University. (McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W. C. 2.) Price Vol. I. 24/- net and Vol. II. 18/- net.

Liverseege's Adulteration and Analysis of Foods and Drugs. (J. & A. Churchill Ltd., 104, Gloucester Place, London, W. 1.) Price 36*s*.

Clayton's Colloid Aspects of Food Chemistry and Technology. 64 Illustrations. (J. & A. Churchill Ltd., 104, Gloucester Place, London, W. 1.) Price 36*s*.

Robsons' Recent Advances in Sex and Reproductive Physiology. 47 Illustrations. (J. & A. Churchill Ltd., 104, Gloucester Place, London, W. 1.) Price 12*s*. 6*d*.

Evolution and Its Modern Critics. By Davies A. Morley. (Thomas Murby and Co., London, 1937.) Price 7*s*. 6*d*. net.

Atlas of Haematology. By Edwin E. Osgood, M.A., M.D., Assistant Professor of Medicine and Head of Experimental Medicine, University of Oregon Medical School and Clarice M. Ashworth, Medical Illustrator, University of Oregon Medical School. (San Francisco : J. W. Stacey, Inc., London : H. K. Lewise and Co., 1937). Price 45*s*.

A History of Land Mammals of the Western Hemisphere. By Prof. William Berryman Scott. Revised Edition. Re-written throughout. (New York ; The MacMillan & Co., 1937). Price 32*s*. net.

Animals and Men—Studies in Comparative Psychology. By David Katz, Professor of the University of Stockholm. (Longmans, Green and Co., Ltd., 39, Paternoster Row, London, E. C. 4.)

Handbook of the Diseases of Animal Acts and Orders of the Minister of Agriculture and Fisheries, 1937. Printed and published by H. M. Stationery Office. Price 7*s*. 6*d*.

The Physiology of Domestic Animals. By H. H. Dukes, D.V.S., M.S. Fourth Revised Edition. (Bailliere, Tindall & Cox, 1937.) Price 30*s*. net.

PLANT QUARANTINE AND OTHER OFFICIAL ANNOUNCEMENTS

Press communiqué dated the 23rd June 1938, issued by the Government of India in the Department of Education, Health and Lands.

THE Government of India have decided that the prohibitions and restrictions imposed on the imports of plants, cotton seed, etc., under the Destructive Insects and Pests Act, 1914, and the rules framed thereunder shall be applied to imports from Burma from the 1st August, 1938.

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Notification No. F. 46-21/38-A., dated the 26th July 1938, issued by the Government of India in the Department of Education, Health and Lands.

IN exercise of the powers conferred by sub-section (1) of section 3 of the Destructive Insects and Pests Act, 1914 (II of 1914), the Central Government is pleased to direct that the following further amendments shall be made in the Order published with the notification of the Government of India in the Department of Education, Health and Lands, No. F.-320/35-A., dated the 20th July 1936, namely :—

(a) In rule 6 of the said Order, after the words " Potatoes shall not be imported into British India by sea " the words " except from Burma ", shall be inserted, and

(b) In the First Schedule to the said Order, the entry

" *Burma.*—Mr. L. P. Khanna, M.Sc., Assistant in Biology, University College, Rangoon ".

in columns (2) and (3) against paragraph 6 (b) shall be omitted

Personal Notes, Appointments and Transfers, Meetings and Conferences, etc.

Imperial Council of Agricultural Research

The services of MR. SUBIMAL DUTT, I.C.S., have been placed at the disposal of the Department of Education, Health and Lands, with effect from the forenoon of the 1st August 1938.

MR. R. D. KAPUR, B.Sc., M.Sc. (Calif.), Chief Economist with the Imperial Council of Agricultural Research for "Enquiry into the Cost of Production of Crops in the Principal Sugarcane and Cotton-Growing Tracts in India" has been granted earned leave for ninety days, with effect from the 1st August 1938, on the expiry of which his services under the Council will terminate.

MR. C. B. SAMUEL, M. A., B.Sc. (Agri.), a Senior Marketing Officer in the Office of the Agricultural Marketing Adviser to the Government of India, has been permitted to resign his appointment from the 5th October 1938.

MR. P. L. TANDON, B.Sc. (Wales), F.R.Econ.S. (Lond.), an Assistant Marketing Officer in the Office of the Agricultural Marketing Adviser to the Government of India, has been appointed temporary Supervising Officer (Grading Stations), with effect from the 1st April 1937 (forenoon).

The services of DR. T. J. MIRCHANDANI, M.Sc., Ph.D., Soil Chemist, Cinchona Enquiry, Imperial Council of Agricultural Research, have been replaced at the disposal of the Bihar Government, with effect from the afternoon of the 31st August 1938.

The services of Mr. P. M. SUNDARAM, B.A., a Superintendent in the Imperial Council of Agricultural Research Department, have been placed temporarily at the disposal of the Director-General, Indian Medical Services, with effect from the forenoon of the 3rd August 1938.

MR. T. S. KRISHNAMURTI, B.A., a member of the Imperial Secretariat Service, Class II, has been appointed to officiate as Superintendent in the Imperial Council of Agricultural Research Department, with effect from the 3rd August 1938 and until further orders, *vice* MR. P. M. SUNDARAM.

Indian Central Cotton Committee

The Durbar of the Gwalior State has nominated LIEUTENANT SARDAR D. K. JADHAV, B.A., Director of Agriculture, Gwalior State, to be a member of the Indian Central Cotton Committee, *vice* MR. G. K. LELE, resigned.

Indian Central Jute Committee

MR. J. E. ORDISH, of Messrs. George Henderson and Company, Limited, Calcutta, has been nominated by the Bengal Chamber of Commerce, to be a member of the Indian Central Jute Committee, *vice* MR. H. A. LUKE, resigned.

Indian Lac Cess Committee

The Central Government have been pleased to appoint MR. A. P. MIDDLETON, I.C.S., Commissioner, Chota-Nagpur Division, Ranchi, to be the President of the the Indian Lac Cess Committee and to be the Chairman of its Governing Body and Advisory Board, with effect from the 20th August 1938, *vice* SIR BRYCE BURT, C.I.E., M.B.E., I.A.S., resigned.

The Central Government have been pleased to appoint Mr. E. F. G. GILMORE, Director, Industrial Research Bureau, New Delhi, as a member of the Governing Body of the Indian Lac Cess Committee.

The Central Government have been pleased to appoint MR. D. G. SEVASTOPULO (of Messrs. Ralli Brothers Limited) nominated by the Bengal Chamber of Commerce to represent the Shellac Export trade, as a member of the Governing Body of the Indian Lac Cess Committee, *vice* MR. A. METAXA, resigned.

The Central Government have been pleased to appoint MR. SHIVASARANLAL JAYASWAL, Village Bundu, District Ranchi, as a member of the Governing Body of the Indian Lac Cess Committee to represent the lac cultivators in Bihar, with effect from the 23rd August 1938, *vice* KHAWAJA HAKIM JAN.

The Central Government have been pleased to appoint Mr. RAMKISHORE LAL JAYASWAL (C/o. Messrs. Gulab Singh Samar Singh, Balarampur, District Manbhum, Bihar) as a member of the Governing Body of the Indian Lac Cess Committee, to represent the indigenous shellac manufacturers, with effect from the 23rd August 1938, *vice* MR. A. M. ARATHOON of Jhalda.

The Central Government have been pleased to appoint MR. W. F. DINES (of Messrs. Angelo Brothers, Limited, Calcutta) as a member of the Advisory Board of the Indian Lac Cess Committee, to represent the Lac Manufacturing Industry, *vice* MR. J. P. YOUNG, resigned.

The Central Government have been pleased to appoint the following persons as members of the Governing Body of the Indian Lac Cess Committee, with effect from the 23rd August 1938 :—

1. MR. W. F. DINES (Of Messrs. Angelo Brothers, Ltd., Calcutta) nominated by the Bengal Chamber of Commerce to represent the Shellac Manufacturing Industry.

2. MR. T. C. MUKHERJEE (C/o. Messrs. D. Mukherjee & Co., 156, Radha Bazaar Street, Calcutta) nominated by the Calcutta Shellac Brokers' Association, to represent the Shellac Manufacturing Industry.

3. MR. HUBERT WIND (of Messrs. The Gramophone Co., Ltd., Dum Dum, Calcutta) to represent the Lac Consuming Industries in India.

Imperial Agricultural Research Institute

DR. S. RAMANUJAM, Assistant, Paddy Section, Agricultural Research Institute, Coimbatore, has been appointed Second Economic Botanist at the Imperial Agricultural Research Institute, New Delhi, on probation for two years, with effect from the forenoon of the 1st September 1938.

Madras

MR. R. C. BROADFOOT, N.D. A., C.D.A. (Hons.) (Glas.), Principal, Agricultural College, Coimbatore, has been appointed Principal and Senior Lecturer in Agriculture, Agricultural College, and Superintendent, Central Farm, Coimbatore.

MR. SAADAT-UL-LAH KHAN, M.A. (Oxon.), Bar.-at-Law, I.A.S., Deputy Director of Agriculture, has been granted leave on average pay for one month from the date of relinquishing charge of the Fourth Circle (Old), St. Thomas' Mount.

MR. R. N. K. SUNDARAM, C.D.A. (Glas.), N.D.D., officiating Deputy Director of Agriculture, Fifth Circle (Old), Trichinopoly, and posted as Assistant Director of Agriculture, Madura, has been appointed officiating Deputy Director of Agriculture, Third Circle (reorganized), Trichinopoly, during the absence of MR. SAADAT-UL-LAH KHAN, on leave. He will also hold full additional charge of the post of Assistant Director of Agriculture, Madura.

MR. K. C. NAIK, Superintendent, Fruit Research Station, Kodur, was granted leave on average pay for nineteen days from the 29th August 1938. He was also permitted to prefix to his leave, Sunday, the 28th August 1938.

During the absence of Mr. NAIK, on Deputation to the 12th International Horticultural Congress at Berlin and leave, MR. T. BUDHAVIDHEYA RAO NAYUDU, L.Ag., Deputy Director of Agriculture, II Circle, Cuddapah, will hold additional charge of the post of Superintendent, Fruit Research Station, Kodur.

MR. C. RAMASWAMI NAYUDU, B.A. (Cantab.), Lecturer in Agriculture, Agricultural College, has been appointed Junior Lecturer in Agriculture, Agicultural College, and Assistant Superintendent, Central Farm, Coimbatore.

Bombay

The Governor of Bombay has been pleased to make the following appointments during the absence on leave of MR. B. S. KADAM, B.Sc. (Iowa), M.Sc. (Cornell), Crop Botanist :—

MR. M. L. PATEL, Cotton Breeder, South Gujarat, to do duty as Crop Botanist.

RAO SAHEB S. H. PRAYAG, Cotton Breeder, Khandesh, to do duty as Cotton Breeder, South Gujarat.

Bengal

MR. SYED MAHMUD ALI, M.R.C.V.S., Assistant Director, Veterinary Services, Nagpur, has been appointed, on probation, to be Deputy Director, Civil Veterinary Department, Bengal, in the Bengal Higher Veterinary Service, with effect from the 25th July 1938.

MR. GOSTHABIHARI PAL, M.Sc., Agricultural Chemist, Bengal, has been granted leave on average pay for two months, with effect from the 17th July 1938, in extension of leave already granted to him.

MR. SAILENDRA NATH SINGHA, G.B.V.C., Lecturer, Bengal Veterinary College, has been appointed to act as Vice-Principal of the College, *vice* CAPTAIN J. M. LAHIRI.

United Provinces

MR. C. H. PARR, B.Sc. (Agri.) (Edin.), I.A.S., Deputy Director of Agriculture, Bundelkhand Circle, Jhansi, has been granted leave on average pay for five months and three days followed by leave on half average pay for twenty-seven days, with effect from 11th May 1938.

MR. C. MAYA DAS, M.A., B.Sc. (Edin.), I.A.S., Deputy Director of Agriculture, Sarda Circle, Lucknow, has been appointed Deputy Director of Agriculture attached to Headquarters, Lucknow, with effect from the date of taking over charge.

MR. VISHNU SHARMA, B.Sc. (Wales), Divisional Superintendent of Agriculture, at present working as State Tube-Well Agricultural Development Officer, Meerut, to officiate as Deputy Director of Agriculture, Sarda Circle, Lucknow, in the United Provinces Agricultural Service, Class I, as a temporary measure.

On relief by MR. C. MAYA DAS, MR. S. D. JOSHI, B. Sc. (Agri.).(Lond.), M.S., E.A.C., Deputy Director of Agriculture attached to Headquarters, has been appointed to be temporary Cane Development Officer, Central Range, Lucknow, in the United Provinces Agricultural Service, Class I.

Mr. T. S. Krishnamurti, B.A., a member of the Imperial Secretariat Service, Class II, has been appointed to officiate as Superintendent in the Imperial Council of Agricultural Research Department, with effect from the 3rd August 1938 and until further orders, *vice* Mr. P. M. Sundaram.

Indian Central Cotton Committee

The Durbar of the Gwalior State has nominated Lieutenant Sardar D. K. Jadhav, B.A., Director of Agriculture, Gwalior State, to be a member of the Indian Central Cotton Committee, *vice* Mr. G. K. Lele, resigned.

Indian Central Jute Committee

Mr. J. E. Ordish, of Messrs. George Henderson and Company, Limited, Calcutta, has been nominated by the Bengal Chamber of Commerce, to be a member of the Indian Central Jute Committee, *vice* Mr. H. A. Luke, resigned.

Indian Lac Cess Committee

The Central Government have been pleased to appoint Mr. A. P. Middleton, I.C.S., Commissioner, Chota-Nagpur Division, Ranchi, to be the President of the the Indian Lac Cess Committee and to be the Chairman of its Governing Body and Advisory Board, with effect from the 20th August 1938, *vice* Sir Bryce Burt, C.I.E., M.B.E., I.A.S., resigned.

The Central Government have been pleased to appoint Mr. E. F. G. Gilmore, Director, Industrial Research Bureau, New Delhi, as a member of the Governing Body of the Indian Lac Cess Committee.

The Central Government have been pleased to appoint Mr. D. G. Sevastopulo (of Messrs. Ralli Brothers Limited) nominated by the Bengal Chamber of Commerce to represent the Shellac Export trade, as a member of the Governing Body of the Indian Lac Cess Committee, *vice* Mr. A. Metaxa, resigned.

The Central Government have been pleased to appoint MR. SHIVASARANLAL JAYASWAL, Village Bundu, District Ranchi, as a member of the Governing Body of the Indian Lac Cess Committee to represent the lac cultivators in Bihar, with effect from the 23rd August 1938, *vice* KHAWAJA HAKIM JAN.

The Central Government have been pleased to appoint Mr. RAMKISHORE LAL JAYASWAL (C/o. Messrs. Gulab Singh Samar Singh, Balarampur, District Manbhum, Bihar) as a member of the Governing Body of the Indian Lac Cess Committee, to represent the indigenous shellac manufacturers, with effect from the 23rd August 1938, *vice* MR. A. M. ARATHOON of Jhalda.

The Central Government have been pleased to appoint MR. W. F. DINES (of Messrs. Angelo Brothers, Limited, Calcutta) as a member of the Advisory Board of the Indian Lac Cess Committee, to represent the Lac Manufacturing Industry, *vice* MR. J. P. YOUNG, resigned.

The Central Government have been pleased to appoint the following persons as members of the Governing Body of the Indian Lac Cess Committee, with effect from the 23rd August 1938 :—

1. MR. W. F. DINES (Of Messrs. Angelo Brothers, Ltd., Calcutta) nominated by the Bengal Chamber of Commerce to represent the Shellac Manufacturing Industry.

2. MR. T. C. MUKHERJEE (C/o. Messrs. D. Mukherjee & Co., 156, Radha Bazaar Street, Calcutta) nominated by the Calcutta Shellac Brokers' Association, to represent the Shellac Manufacturing Industry.

3. MR. HUBERT WIND (of Messrs. The Gramophone Co., Ltd., Dum Dum, Calcutta) to represent the Lac Consuming Industries in India.

Imperial Agricultural Research Institute

DR. S. RAMANUJAM, Assistant, Paddy Section, Agricultural Research Institute, Coimbatore, has been appointed Second Economic Botanist at the Imperial Agricultural Research Institute, New Delhi, on probation for two years, with effect from the forenoon of the 1st September 1938.

Madras

MR. R. C. BROADFOOT, N.D. A., C.D.A. (Hons.) (Glas.), Principal, Agricultural College, Coimbatore, has been appointed Principal and Senior Lecturer in Agriculture, Agricultural College, and Superintendent, Central Farm, Coimbatore.

MR. SAADAT-UL-LAH KHAN, M.A. (Oxon.), Bar.-at-Law, I.A.S., Deputy Director of Agriculture, has been granted leave on average pay for one month from the date of relinquishing charge of the Fourth Circle (Old), St. Thomas' Mount.

MR. R. N. K. SUNDARAM, C.D.A. (Glas.), N.D.D., officiating Deputy Director of Agriculture, Fifth Circle (Old), Trichinopoly, and posted as Assistant Director of Agriculture, Madura, has been appointed officiating Deputy Director of Agriculture, Third Circle (reorganized), Trichinopoly, during the absence of MR. SAADAT-UL-LAH KHAN, on leave. He will also hold full additional charge of the post of Assistant Director of Agriculture, Madura.

MR. K. C. NAIK, Superintendent, Fruit Research Station, Kodur, was granted leave on average pay for nineteen days from the 29th August 1938. He was also permitted to prefix to his leave, Sunday, the 28th August 1938.

During the absence of Mr. NAIK, on Deputation to the 12th International Horticultural Congress at Berlin and leave, MR. T. BUDHAVIDHEYA RAO NAYUDU, L.Ag., Deputy Director of Agriculture, II Circle, Cuddapah, will hold additional charge of the post of Superintendent, Fruit Research Station, Kodur.

MR. C. RAMASWAMI NAYUDU, B.A. (Cantab.), Lecturer in Agriculture, Agricultural College, has been appointed Junior Lecturer in Agriculture, Agicultural College, and Assistant Superintendent, Central Farm, Coimbatore.

Bombay

The Governor of Bombay has been pleased to make the following appointments during the absence on leave of MR. B. S. KADAM, B.Sc. (Iowa), M.Sc. (Cornell), Crop Botanist :—

MR. M. L. PATEL, Cotton Breeder, South Gujarat, to do duty as Crop Botanist.

RAO SAHEB S. H. PRAYAG, Cotton Breeder, Khandesh, to do duty as Cotton Breeder, South Gujarat.

Bengal

MR. SYED MAHMUD ALI, M.R.C.V.S., Assistant Director, Veterinary Services, Nagpur, has been appointed, on probation, to be Deputy Director, Civil Veterinary Department, Bengal, in the Bengal Higher Veterinary Service, with effect from the 25th July 1938.

MR. GOSTHABIHARI PAL, M.Sc., Agricultural Chemist, Bengal, has been granted leave on average pay for two months, with effect from the 17th July 1938, in extension of leave already granted to him.

MR. SAILENDRA NATH SINGHA, G.B.V.C., Lecturer, Bengal Veterinary College, has been appointed to act as Vice-Principal of the College, *vice* CAPTAIN J. M. LAHIRI.

United Provinces

MR. C. H. PARR, B.Sc. (Agri.) (Edin.), I.A.S.. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi, has been granted leave on average pay for five months and three days followed by leave on half average pay for twenty-seven days, with effect from 11th May 1938.

MR. C. MAYA DAS, M.A., B.Sc. (Edin.), I.A.S., Deputy Director of Agriculture, Sarda Circle, Lucknow, has been appointed Deputy Director of Agriculture attached to Headquarters, Lucknow, with effect from the date of taking over charge.

MR. VISHNU SHARMA, B.Sc. (Wales), Divisional Superintendent of Agriculture, at present working as State Tube-Well Agricultural Development Officer, Meerut, to officiate as Deputy Director of Agriculture, Sarda Circle, Lucknow, in the United Provinces Agricultural Service, Class I, as a temporary measure.

On relief by MR. C. MAYA DAS, MR. S. D. JOSHI, B. Sc. (Agri.).(Lond.), M.S., E.A.C., Deputy Director of Agriculture attached to Headquarters, has been appointed to be temporary Cane Development Officer, Central Range, Lucknow, in the United Provinces Agricultural Service, Class I.

DR. BIMAL KUMAR MUKERJI, Ph.D., D.Sc., has been confirmed in the United Provinces Agricultural Service, Class I, as Agricultural Chemist to Government, United Provinces, with effect from the 1st July 1938.

DR. R. N. MATHUR, M.Sc., Ph.D., Cane Physiologist, Shahjahanpur, has been granted leave on average pay from 22nd August to 21st October 1938, prefixed by Sunday, the 21st August, and suffixed by public holidays from 22nd to 24th October 1938.

DR. B. L. SETHI, M.Sc. (Punj.), Ph.D. (Wales), officiating Economic Botanist (Cotton and *Rabi* Cereals), has been appointed to be Economic Botanist (Cotton and *Rabi* Cereals), on probation from 16th February, 1938, *vice* RAI SAHIB THAKUR RAMA PRASADA SINGH, retired.

Punjab

On return from leave, KHAN SAHIB AGA YUSUF ALI KHAN, Deputy Director of Agriculture, has been posted to Hansi, with effect from the 11th July 1938, relieving KHAN SAHIB CH. MOHAMMAD ABDULLA, Deputy Director of Agriculture.

KHAN SAHIB CH. MOHAMMAD ABDULLA, I.A.S., Deputy Director of Agriculture, Hansi, has been transferred to Rawalpindi, with effect from the 18th July 1938, relieving MIAN MUKHTAR NABI, in charge of the duties of the Deputy Director of Agriculture, granted leave.

DR. MULK RAJ MADHOK, Research Assistant in Agricultural Bacteriology, Punjab Agricultural College, Lyallpur, has been appointed Agricultural Bacteriologist in the Punjab Agricultural Service, Class I, with effect from the 25th July 1938 on probation for two years.

KHAN SAHIB M. MOHAMMAD ABDULLAH, P.V.S., has retired from the Punjab Veterinary Service from the 1st July 1938.

SARDAR SAHIB SARDAR LABH SINGH, L.Ag., B.Sc. (Agri.) (Punj.), Professor of Agriculture, Punjab Agricultural College, and Deputy Director of Agriculture, Lyallpur, has been granted leave on average pay for four months, with effect from the 16th July 1938.

MALIK AMANAT KHAN, B.Sc. (Agri.) (Edin.), Officiating Associate Professor of Agriculture, Punjab Agricultural College, Lyallpur, has been appointed in charge of the duties of the Professor of Agriculture, Punjab Agricultural College and of the Deputy Director of Agriculture, Lyallpur, with effect from the 16th July 1938, in addition to his own duties and relieving S. S. SARDAR LABH SINGH, granted leave.

Central Provinces

MR. P. S. NAIR, G.B.V.C., Assistant Director of Veterinary Services, Central Provinces and Berar, attached to the office of the Director of Veterinary Services, Central Provinces and Berar, has been placed incharge of the Veterinary Laboratory, Nagpur, in addition to his own duties, with effect from the 23rd July 1938.

On relief by MR. P. S. NAIR, G.B.V.C., the services of MR. SYED MAHMUD ALI, B.Sc., M.R.C.V.S., Assistant Director of Veterinary Services, in charge, Veterinary Laboratory, Nagpur, are placed at the disposal of the Government of Bengal.

On return from leave, MR. J. F. DASTUR, M.Sc., D.I.C., has been reposted as Mycologist to Government, Central Provinces and Berar, Nagpur.

On return from leave, MR. BALBIR SINGH, M.Sc., M.R.C.V.S., is reposted as Assistant Director of Veterinary Services, Chhattisgarh Division, Raipur.

On relief by MR. BALBIR SINGH, M.Sc., M.R.C.V.S., MR. M. JAMES, officiating Assistant Director of Veterinary Services, reverts to his substantive post of Veterinary Inspector.

Assam

MR. FAZLUL HAQUE, Dip.-Agri. (Bom.), Deputy Director of Agriculture, Upper Assam Valley, has been granted leave on average pay for four months, with effect from the 3rd August 1938.

Orissa

MR. H. L. DUTTA, B.A. (Cal.), M.Sc.A. (Cornell), Deputy Director of Agriculture, Orissa, has been confirmed in Class I of the Provincial Agricultural Service, with effect from the 1st April 1937.

RECENT PUBLICATIONS OF THE IMPERIAL AGRICULTURAL BUREAUX

I. Obtainable from the Imperial Bureau of Soil Science, Rothamsted Experimental Station, Harpenden, Herts

Periodical Abstracts

Lists of publications and papers on Soil Science published in the Empire Overseas in—

	Price *s.*	*d.*
1933	1	0
1934	1	0
Soil Research in the British Empire published during 1935	1	0
Soils and Fertilisers (continuation of Publications relating to Soils and Fertilizers). Vol. I (1938) No. 1—		
Issued six times yearly. Subscription rate per annum	20	0

Occasional Papers

Technical Communications—		
35. Design and Analysis of Factorial Experiments. By F. Yates. .	5	0
36. Erosion and Soil Conservation	5	0
37. Soil Structure. By E. J. Russell	2	0
Annual Report: For the year 1934-35	0	6
" " " 1936-37 (8th report)	0	6
Bibliographies—		
Bibliography on Coffee	2	0
Catalogue of Journals and Periodicals in the Library of Rothamsted Experimental Station	2	0
Special Publication—		
The Katamorphism of Igneous Rocks under Humid Tropical Conditions. By the late Sir. J. B. Harrison	5	0
Bibliography of Soil Science, Fertilizers and General Agronomy, 1934-37	25	0

II. Obtainable from the Imperial Bureau of Animal Health, Veterinary Research Laboratory, New Haw, Weybridge, Surrey

Abstracting Journal

The Veterinary Bulletin—		
1931. Vol. 1. Quarterly (1st Number, April)	7	6
Annual subscription	20	0
Subsequent volumes. Monthly (1st Number, January)	5	0
Annual subscription (postage paid) (vol. 8 current)	40	0

	Price s. d.
Indexing Publication	
Index Veterinarius—Four issues a year. First issue April 1933—	
Annual subscription (postage paid). Volumes I to III mimeographed. Volume IV onwards printed (vol. 6 current)	100 0
Occasional Papers	
Review series—	
No. 1. Bovine Mastitis. By E. M. Peterson	10 0

III. Obtainable from the Imperial Bureau of Animal Nutrition, Rowett Research Institute, Bucksburn, Aberdeen

Journal	
Nutrition Abstracts and Reviews. (Issued under the direction of the Imperial Agricultural Bureaux Council, the Medical Research Council and the Reid Library)—	
Subscription per volume of 4 numbers (vol. 8 current)	42 0
Per single number	13 0
Occasional Papers	
Technical Communications—	
8. Nutrition Research in the British Colonial Empire	1 0
9. Methods for Chemical Analysis of Biological Material in Nutrition Investigations	1 0
10. Table of Composition of Foods giving Energy, Value, Protein, Fat, Carbohydrate, Calcium, Phosphorus and Iron Content of Some 300 Foods Commonly used in Great Britain and Compiled for Use in the Analysis of Dietary Surveys	1 0
Occasional Communications—	
2. Etiology of Epidemic Goitre.	

IV. Obtainable from the Imperial Bureau of Plant Breeding and Genetics, Plant Breeding Institute, School of Agriculture, Cambridge

Journal	
Plant Breeding Abstracts—	
Quarterly. Annual subscription (vol. 8 current)	25 0
Single copies	7 6
Occasional Papers	
Indexes to Plant Breeding Abstracts—	
Subject Index to Vols. I to V of Plant Breeding Abstracts	5 0
„ „ „ Vol. VI and Vols. VI-VII, each	2 6
Supplements to Plant Breeding Abstracts—	
Summary of Reports received from Countries exclusive of the British Empire, 1928-31. Supplement I	2 6
Summary of Reports received from Stations in the British Empire, 1932-1935. Supplement II	5 0

	Price s. d.
Technical Communications—	
Vernalization and Phasic Development of Plants (Joint Publication of the Imperial Bureaux of Plant Genetics)	10 0
Bibliographical Monographs—	
South American Potatoes and their Breeding Value	3 6
Tobacco Breeding Bibliography	1 0

V. OBTAINABLE FROM THE IMPERIAL BUREAU OF PASTURES AND FORAGE CROPS, WELSH PLANT BREEDING STATION, AGRICULTURAL BUILDINGS, ALEXANDRA ROAD, ABERYSTWYTH, WALES

Journals

Herbage Abstracts—	
Quarterly. Annual subscription (vol. 8 current).	15 0
Single number	5 0
Herbage Reviews—	
Subscription is at present—Vol. 1 (1933), Vol. 2 (1934), Vol. 3 (1935), Vol. 4 (1936)—included in the Herbage Abstracts (vol. 6 current) .	

Occasional Papers

Bulletins—	
25. Erosion and Soil Conservation. By G. V. Jacks and R. O. Whyte .	5 0

VI. OBTAINABLE FROM THE IMPERIAL BUREAU OF HORTICULTURE AND PLANTATION CROPS, EAST MALLING RESEARCH STATION, EAST MALLING, KENT

Journal

Horticultural Abstracts—	
A quarterly abstract publication of current horticultural literature—	
Annual subscription (vol. 8 current)	15 0
Single copy	4 0

Technical Communications

9. Review of the Literature on Stock-scion Incompatability in Fruit Trees, with particular reference to Pome and Stone Fruits. G. K. Argles	5 0
10. Plant Injection for Diagnostic and Curative purposes, 1938. By W. A. Roach	5 0

Occasional Papers

5. The Frame-working of Fruit Trees. R. J. Garner and W. F. Walker, 1938	1 0

	Price s. d.
Other Publications—	
Index to Volumes I—X of the *Journal of Pomology and Horticultural Science*, 1933. Compiled by Bureau, published by the Editors of the *Journal of Pomology and Horticultural Science*. Available from the Bureau	5 0
Old and New Standpoints on Senile Degeneration, 1931. By. A. P. C. Bijhouwer	0 6

VII. OBTAINABLE FROM THE IMPERIAL BUREAU OF ANIMAL BREEDING AND GENETICS, INSTITUTE OF ANIMAL GENETICS, UNIVERSITY OF EDINBURGH, KING'S BUILDINGS, WEST MAINS ROAD, EDINBURGH

Journal

Animal Breeding Abstracts (Quarterly). Commencing April, 1933.	
Annual subscription (vol. 6 current)	25 0
Occasional Papers	
Animal Breeding in the British Empire. A Survey of Research and Experiment, 1934	2 0

VIII. OBTAINABLE FROM THE IMPERIAL BUREAU OF AGRICULTURAL PARASITOLOGY (HELMINTHOLOGY), INSTITUTE OF AGRICULTURAL PARASITOLOGY, WINCHES FARM DRIVE, HATFIELD ROAD, ST. ALBANS, HERTS

Journals

Bibliography of Heliminthology. For the year 1933—	
Library edition, bound in cloth	10 6
Stiff paper cover only	8 0
(From 1934 incorporated with Helminthological Abstracts)	
Helminthological Abstracts. (Issued in five or six parts per volume, each volume covering the literature of a single year). Subscription per volume, payable in advance	30 0
Completed volumes bound in cloth	32 0
Occasional Papers	
Helminth Parasites of New Zealand. By M. R. Young	4 0
Notes and Memoranda—	
11. Recent Developments in the Control of *Heterodera marioni*, 6 pp. .	1 6

PUBLICATIONS ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY, 41, QUEEN'S GATE, LONDON, S. W. 7

Bulletin of Entomological Research—	
Published quarterly and containing original articles on Economic Entomology. Issued post-free.	
Annual subscription (payable in advance) (vol. 28 current)	30 0

Review of Applied Entomology—

Consisting of abstracts or reviews of all current literature on Economic Entomology throughout the world. Published monthly in two series. Series 'A' dealing with insect and other arthropod pests of cultivated plants, forest trees and stored products of animal and vegetable origin, Series 'B' dealing with insects, ticks, etc., conveying disease or otherwise injurious to man and animals. Issued post-free. (vol. 26 current).

	Series 'A'	Series 'B'
	s.	*s.*
Annual subscription (payable in advance)	30	15
Vol. XXIII (1935)	42	21

Zoological Record—Part Insecta—

Published annually about July in each year and containing as complete a record as possible of the literature of the previous year chiefly from the systematic standpoint.

	s.	*d.*
Annual subscription (including postage)	15	6
Report of the Fourth Imperial Entomological Conference. 19—27th September 1935	4	0
Biological control of an Insect in Fizi. An account of the Coconut leaf Mining Beetle and its Parasite Complex. By T. H. C. Taylor.	12	0

PUBLICATIONS OBTAINABLE FROM THE IMPERIAL MYCOLOGICAL INSTITUTE, KEW, SURREY

Journal

Review of Applied Mycology—

Annual subscription, 12 monthly parts, with title page and index (post-free)	21	0
Single part	2	0
Title page and index	3	0
Report on the Third Imperial Mycological Conference, 1934	2	0
Annotated account of fungi received at the Imperial Mycological Institute. List II. Fasc. 1. By E. W. Mason	1	0
Annotated account of fungi received at the Imperial Mycological Institute. List II, Fasc. 2. By E. W. Mason	2	0
Annotated account of fungi received at the Imperial Mycological Institute. List II, Fasc. 3. By E. W. Mason	1	0
A list of Mycologist resident in the British Empire, 1938. 5th Edn. January 1938	1	0

List of Agricultural and Animal Husbandry Publications in India from 1st February to 31st July 1938

Title	Author	Where published
GENERAL AGRICULTURE		
Agriculture and Live-stock in India, Vol. VIII, Parts 2 to 4. Annual subscription Rs. 6 or 9*s*. 9*d*. (A bi-monthly Journal of agriculture and animal husbandry for the general reader interested in agriculture or live-stock in India or the Tropics)	Issued under the authority of the Imperial Council of Agricultural Research	Manager of Publications, Civil Lines, Delhi.
The Madras Agricultural Journal. Monthly. Annual subscription Rs. 4	M. U. Vellodi (Editor). Published by the M. A. S. Union, Agricultural Research Institute, Coimbatore	The Secretary, M. A. S. Union, Agricultural College, Lawley Road, P. O.
The Journal of the Trichinopoly District Agricultural Association (English and Tamil). Quarterly. Annual subscription Re. 1-8-0 for non-members, free for members	Issued by the Trichinopoly District Agricultural Association, Teppakulam Post	The Secretary, The Trichinopoly District Agricultural Association, Teppakulam Post
The Journal of the Mysore Agricultural and Experimental Union (English). Quarterly. Price As. 13 or 1*s*. 3*d*. per copy	Dr. V. K. Badami (Chief Editor)	The Secretary, The Mysore Agricultural and Experimental Union, Seshadri Road, Bangalore
Mysore Vyavasaya Shodhaka Sanghada Patrike. Monthly. Price As. 4 per copy	N. Venkatsubbaya (Chief Editor)	Ditto
The Poona Agricultural College Magazine. Quarterly. Annual subscription Rs. 2-8-0	V. G. Deshpande and S. M. Rao (Editors)	The Editor, *Poona Agricultural College Magazine*, Poona
Shetki Shetkari (Marathi). Monthly. Annual subscription Re. 1-3-0	Vasudev Ganesh Pande	The Editor, *Shetki Shetkari*, Agricultural College, Poona

GENERAL AGRICULTURE—*contd.*

Title	Author	Where published
The Planters' Journal and Agriculturist. Fortnightly. Annual subscription Rs. 10 or 16*s*.	Theo H. Thorne (Editor)	The Manager, *The Planters' Journal and Agriculturist,* 13, Ezra Mansions, Calcutta
Krishi-sampad (Bengali). Monthly. Annual subscription Rs. 3	N. K. Ghosh (Editor)	The Manager, *Krishi-sampad* Office, Dacca
The Mufidul Mazarin (Urdu). Annual subscription Re. 1 for subscribers in United Provinces and Re. 1-8-0 for subscribers outside the Province	C. C. Sanyal (Editor), Government Agricultural Journals	Office of the Editor, Government Agricultural Journals, Sikandarbagh, Lucknow
The Kisan Upkarak (Hindi). Annual subscription Re. 1 for subscribers in United Provinces and Re. 1-8-0 for subscribers outside the province	Ditto	Ditto
The Allahabad Farmer. Bi-monthly. Annual subscription in India Rs. 2	B. M. Pugh (Editor). Published by the Agricultural Institute, Allahabad	The Allahabad Agricultural Institute, United Provinces (American Presbyterian Mission), Allahabad
Seasonal Notes. Price As. 4 per copy	Issued by the Department of Agriculture, Punjab	Government Printing, Punjab, Lahore
The Nagpur Agricultural College Magazine. Quarterly. Annual subscription Rs. 3	Published by P. D. Nair, Agricultural College, Nagpur	The Editor, *The Nagpur Agricultural College Magazine,* College of Agriculture, Nagpur
Kisan (Hindi). Quarterly. Annual subscription Rs. 2, As. 8 per copy	Issued by the Agricultural Association, Bihar and Orissa	B. N. Sircar, Senior Marketing Officer and Editor, *Kisan*, Patna
Report on An Enquiry into the Cultivation of Cloves in India. Miscellaneous Bulletin No. 20 of the Imperial Council of Agricultural Research. Price Rs. 2-4-0 or 3*s*. 9*d*.	A. K. Yegna Narayana Aiyer	Manager of Publications, Civil Lines, Delhi

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Abridged Editions of the Report on the Marketing of Wheat in India (English, Hindi and Urdu). Price As. 8 each	Issued by the Agricultural Marketing Adviser to the Government of India, Delhi	Manager of Publications, Civil Lines, Delhi
Annual Report of the Agricultural Marketing Adviser and Summarized Reports of Senior Marketing Officers in Provinces and Certain States for the year ending 31st December 1937. Price As. 6	Ditto .	Ditto
Report on the Marketing of Linseed in India. Price Re. 1-4-0	Ditto .	Ditto
Annual Report of the Indian Central Cotton Committee, Bombay, for the year ending 31st August 1937. Price Rs. 2-0-0	Issued by the Indian Central Cotton Committee, Bombay	Secretary, Indian Central Cotton Committee, Bombay
A Guide to Indian Cottons (Marathi, Gujerati and Kanarese). Price As. 6 each	Ditto .	Ditto
Summary Proceedings of the 35th Meeting of the Indian Central Cotton Committee, Bombay. Price Re. 1	Ditto .	Ditto
First Annual Report of the Indian Central Jute Committee for the period from 1st December 1936 to 31st March 1938. Free	Issued by the Indian Central Jute Committee, Calcutta	Secretary, Indian Central Jute Committee, 1, Council House Street, Calcutta
Agricultural Research and the Indian Farmer. Unpriced Publication	Issued by the Imperial Agricultural Research Institute, New Delhi	Director, Imperial Agricultural Research Institute, New Delhi
Improved Circular Mhote Water-lift for Bullock Power. Leaflet No. 86 of the Department of Agriculture, Madras. Free	N. G. Charley . .	Government Press, Madras
On Coconut Cultivation (Telugu). Pamphlet No. 8 of the Department of Agriculture, Madras. Free	J. S. Patel . . .	Ditto

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Note on Nilgiri Agriculture (Kanarese). Pamphlet No. 10 of the Department of Agriculture, Madras. Free	D. G. Munro . .	Government Press Madras
On Improved Groundnut (Tamil, Telugu, Malayalam and Kanarese). Pamphlet No. 12 of the Department of Agriculture, Madras. Free	J. S. Patel . . .	Ditto
Feed Your Bullock (Telugu and Malayalam). (Reprinted). Broad Hint No. 1 of the Department of Agriculture, Madras. Free	G. R. Hilson . .	Ditto
Plough Early (Telugu). (Reprinted). Broad Hint No. 3 of the Department of Agriculture, Madras. Free	Rao Bahadur D. Ananda Rao	Ditto
Plough Efficiently (Telugu and Malayalam). (Reprinted). Broad Hint No. 4 of the Department of Agriculture, Madras. Free	Ditto .	Ditto
Sow Good Seed (Telugu and Malayalam). (Reprinted). Broad Hint No. 5 of the Department of Agriculture, Madras. Free	G. R. Hilson . .	Ditto
Beware of Weeds (Tamil, Telugu and Malayalam). (Reprinted). Broad Hint No. 6 of the Department of Agriculture, Madras. Free	Ditto .	Ditto
Monograph on Coconut (English). Price Rs. 3-12-0	J. S. Patel . . .	Ditto
Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1936-37. Price As. 12	Issued by the Department of Agriculture, Bombay Presidency	Government Central Press. Bombay
Mustard. Leaflet No. 4 of the Department of Agriculture, Bengal. Free	Issued by the Department of Agriculture, Bengal	Superintendent, Government Printing, Bengal

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Improved Mustard Strains and their Importance in the Cultivation and Industries of the United Provinces. Leaflet No. 58 of the Department of Agriculture, United Provinces. Free in U. P. only	Issued by the Department of Agriculture, United Provinces	1. Deputy Director of Agriculture, Sarda Circle, Lucknow 2. Deputy Director of Agriculture, Western Circle, Aligarh 3. Deputy Director of Agriculture, Bundelkhand Circle, Jhansi 4. Deputy Director Agriculture, Eastern Circle, Partabgarh 5. Deputy Director of Agriculture, North-Eastern Circle, Gorakhpur 6. Deputy Director of Agriculture, Rohilkhand and Kumaun Circle, Bareilly
Improved Groundnut Strains and their Importance in the Cultivation and Industries of the United Provinces. Leaflet No. 59 of the Department of Agriculture, United Provinces. Free in U. P. only	Ditto .	
A Note on Improved Tobacco (Virginian Tobacco). Free	H. D. Singh Gupta .	Deputy Director of Agriculture, Sarda Circle, Lucknow
Soya-bean Cultivation in the Punjab. Leaflet No. 146 of the Department of Agriculture, Punjab. Free	Issued by the Department of Agriculture, Punjab, Lahore	Superintendent, Government Printing, Punjab, Lahore
Annual Report of the Department of Agriculture, Punjab, for the year ending 30th June 1937. Price As. 8	Ditto .	Ditto
Report on the Working of the Department of Agriculture, Central Provinces and Berar, for the year ending 31st March 1937. Price Re. 1-8-0	Issued by the Department of Agriculture, Central Provinces and Berar, Nagpur	Superintendent, Government Printing, Nagpur
Report on Demonstration Work carried out in the Northern Circle, together with Reports on the Seed and Demonstration and Cattle-Breeding Farms of the Circle for the year ending the 31st March 1937. Price Re. 1-8-0	Ditto .	Ditto

Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
Report on Demonstration Work carried out in the Eastern Circle together with Reports on the Seed and Demonstration and Cattle-Breeding Farm of the Circle for the year ending the 31st March 1937. Price Re. 1-8-0	Issued by the Department of Agriculture, Central Provinces and Berar, Nagpur	Superintendent, Government Printing, Nagpur
Report on Demonstration Work carried out in the Western Circle together with Reports on the Seed and Demonstration and Cattle-Breeding Farm of the Circle for the year ending the 31st March 1937. Price Re. 1-8-0	Ditto .	Ditto
Report on Demonstration Work carried out in the Southern Circle, together with Reports on the Seed and Demonstration Farms of the Circle for the year ending the 31st March 1937. Price Re. 1-8-0	Ditto .	Ditto
Annual Report on Experimental Farms, Nagpur, Akola, Adhartal, Chhindwara, Powarkhera, Raipur and Tharsa for the year ending the 31st March 1937. Price Re. 1-8-0	Ditto .	Ditto
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Title	Author	Where published
GENERAL AGRICULTURE—*contd.*		
The Potato in Assam. Bulletin No. 2 of the Department of Agriculture, Assam. Free	R. C. Woodford . .	Director of Agriculture, Assam, Shillong
Soya-bean. Leaflet No. 1 of 1938 of the Department of Agriculture, Assam. Free	Issued by the Department of Agriculture, Assam, Shillong	Ditto
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The *Arhar* (Pegeon Pea-*Cajanus indicus*). Leaflet No. 13 of 1938 of the Department of Agriculture, Assam. Free	Ditto .	Ditto
The Spanish Chestnut. Leaflet No. 14 of the Department of Agriculture, Assam (Revised Bulletin No. 3 of 1904). Free	Ditto .	Ditto
Annual Report of the Department of Agriculture, Mysore for 1936-37. Price Re. 1-8-0	Issued by the Department of Agriculture, Mysore	Director of Agriculture, Mysore, Bangalore
Mysore Agricultural Calendar for 1938. Price As. 2	Ditto .	Ditto
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The Elimination of Foreign Matter in Tea	C. J. Harrison . .	Assistant Secretary, Indian Tea Association, Royal Exchange Buildings, Calcutta
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Proceedings of the Second Annual Conference, held at Tocklai, 1938	Issued by the Indian Tea Association, Cinnamara, P. O.	Ditto
AGRICULTURAL STATISTICS		
Report on the Staple Length of Indian Cotton Crops of 1937-38 Season. Statistical Leaflet No. 1 of the Indian Central Cotton Committee. Fifth Issue (1937-38). Price anna 1	Issued by the Secretary, Indian Central Cotton Committee, Bombay .	Secretary, Indian Central Cotton Committee, Bombay
Report on the Accuracy of the All-India Cotton Forecasts of 1936-37 Season. Statistical Leaflet No. 5 of the Indian Central Cotton Committee. Second Issue (1936-37). Price As. 2	Ditto .	Ditto
Monthly Bulletins (Nos. 1-4) for the Months of April to July 1938 containing information and statistics relating to Jute. Free	Issued by the Indian Central Jute Committee, Calcutta	Secretary, Indian Central Jute Committee, 1, Council House Street, Calcutta
Season and Crop Report of the Bombay Presidency for the year 1936-37. Price As. 4	Issued by the Department of Agriculture, Bombay Presidency, Poona	Government Central Press, Bombay
Season and Crop Report of Bengal for 1937-38. Price As. 4	Issued by the Department of Agriculture, Bengal.	Superintendent, Government Printing, Bengal
Agricultural Statistics, Bihar. 1936-37. (*In press*)	Issued by the Department of Agriculture, Bihar	Government Press, Bihar, Gulzarbagh
The Delimitation of Areas for Strains of Agricultural Crops with Special Reference to Cotton. Indian Central Cotton Committee Proceedings of the First Conference of Scientific Research Workers on Cotton in India. Cotton Statistical paper No. 1	V. G. Panse . . .	Director, Institute of Plant Industry and Agricultural Adviser to States in Central India and Rajputana, Indore

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SUGAR RESEARCH		
First and Second Memoranda on the Production of Sugar direct from Cane during the Season 1937-38. Supplied free to sugar factories	Issued by the Director, Imperial Institute of Sugar Technology, Cawnpore	Director, Imperial Institute of Sugar Technology, Cawnpore
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COTTON TECHNOLOGY		
Annual Report of the Director, Technological Laboratory, Matunga, for the year ending 31st May 1938. Price As. 6	Issued by the Secretary, Indian Central Cotton Committee, Bombay	Secretary, Indian Central Cotton Committee, Bombay
Empirical Relationships between Count, Lea Strength and Staple Length of Indian Cottons. (Technological Bulletin Series A, No. 42). Price As. 8	V. Venkataraman and Dr. Nazir Ahmad	Ditto
Suitability of two Cottons for Purposes of Mill Mixings in Relation to their Fibre Characters. (Technological Bulletin Series A, No. 43). Price Re. 1	Dr. Nazir Ahmad and K. R. Sen	Ditto

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COTTON TECHNOLOGY—*contd.*		
A Device for determining the Proportion by Weight of Fibres of Different Lengths in a Sample of Cotton. (Technological Bulletin Series B, No. 23). Price As. 8	Dr. Nazir Ahmad and C. Nanjundayya	Secretary, Indian Central Cotton Committee, Bombay
Studies in the Variation of Strength and Weight per Inch with Group Length of Cotton Fibres. (Technological Bulletin Series B, No. 24). Price Re. 1	C. Nanjundayya and Dr. Nazir Ahmad	Ditto
The Clinging Power of Single Cotton Fibre in relation to its Physical Properties. (Technological Bulletin Series B, No. 25). Price As. 8	K. R. Sen and Dr. Nazir Ahmad	Ditto
Spinning Test Report (No. 918) on Samples of Khandesh Cotton, 1937-38. (Technological Circular No. 326). Price As. 4	Dr. Nazir Ahmad . .	Ditto
Technological Report on Late Verum (Nagpur) 1937-38. (Technological Circular No. 327). Price As. 4	Ditto .	Ditto
Spinning Test Report (No. 919) on Samples of Berar Cotton, 1937-38. (Technological Circular No. 328). Price As. 4	Ditto .	Ditto
Spinning Test Report (No. 921) on Samples of Punjab-American Cotton, 1937-38. (Technological Circular No. 329). Price As. 4	Ditto .	Ditto
Spinning Test Report (No. 922) on Samples of Central Provinces No. 1 Cotton, 1937-38. (Technological Circular No. 330). Price As. 4	Ditto .	Ditto

Title	Author	Where published
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Technological Report on Umri Bani, 1937-38. (Technological Circular No. 331). Price As. 4	Dr. Nazir Ahmad . .	Secretary, Indian Central Cotton Committee, Bombay
Spinning Test Report (No. 925) on Samples of Ujjain Cotton, 1937-38. (Technological Circular No. 332). Price As. 4	Ditto .	Ditto
Spinning Test Report (No. 926) on Samples of Khandesh Cotton, 1937-38. (Technological Circular No. 333). Price As. 4	Ditto .	Ditto
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Technological Report on Verum 434 (Akola), 1937-38. (Technological Circular No. 336). Price As. 4	Ditto .	Ditto
Spinning Test Report (No. 934) on Samples of Broach Cotton, 1937-38. (Technological Circular No. 337). Price As. 4	Ditto .	Ditto
Technological Report on Verum 262 (Akola), 1937-38. (Technological Circular No. 338). Price As. 4	Ditto .	Ditto
Spinning Test Report (No. 939) on Samples of Bailhongal Cotton, 1937-38. (Technological Circular No. 339). Price As. 4	Ditto .	Ditto

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COTTON TECHNOLOGY—*contd.*		
Spinning Test Report (No. 940) on Samples of Miraj Cotton, 1937-38. (Technological Circular No. 340). Price As. 4	Dr. Nazir Ahmad.	Secretary, Indian Central Cotton Committee, Bombay
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Technological Report on Punjab-American 4-F, 1937-38. (Technological Circular No. 342). Price As. 4	Ditto	Ditto
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Spinning Test Report (No. 948) on Samples of Kampala Cotton, 1937-38. (Technological Circular No. 349). Price As. 4	D. L. Sen . . .	Secretary, Indian Central Cotton Committee, Bombay
Spinning Test Report (No. 950) on Samples of Tiruppur Cambodia Cotton, 1937-38. (Technological Circular No. 350). Price As. 4	Ditto .	Ditto
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Title	Author	Where published
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AGRICULTURAL SCIENCE—*contd.*

Entomology—*contd.*

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Title	Author	Where published
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Title	Author	Where published
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9. Miscellaneous

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